

Aviation Week

Including Space Technology

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November 16, 1959

Okanagan Pilots
Fly Mountain,
Bush Missions

Second Little Joe Flight



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(Continued from page 5)

- It Plus, chief Air Force scientist, will speak on "High Temperature in Hyper-sonic Flow, Special Principles and Experimental Techniques." It Plus will report his lecture on Dec. 18 before the 44th Cleveland Section, on Dec. 21 before the 145th Los Angeles Section, and Dec. 22 before the 145th Texas Section.
- Dec. 26-31—Ninth King Kong International Model Place Meet, Miami, Fla.
- Jan. 10-12—Sixth National Symposium on Reliability and Quality Control in Electronics, Studio-Hilton Hotel, Washington, D. C.
- Jan. 12-16—16th Annual Technical Conference, Society of Plasma Engineers, Omni and Hilton Hotel, Cherry, N.J.
- Jan. 14-15—Sixth Annual Meeting, American Astronautical Society, Studio-Hilton Hotel, New York, N. Y.
- Jan. 15-25—25th Annual Meeting, Institute of the Aeronautical Sciences, Hotel Astor, New York, N. Y. (Honor Night Dinner, Jan. 26).
- Jan. 26—26th Annual Propulsion Conference, American Rocket Society, Princeton University, Princeton, N. J.
- Feb. 3-4—Sixth Annual Modern Welding Conference, Elmside Park Chemistry Bldg., Cherry, N.J. (Sponsored by American Rocket Society, American Institute of Technology, Chicago Section, American Welding Society).
- Feb. 8-10—1968 Winter Conference on Military Electronics, Institute of Radio Engineers, Ambassador Hotel, Los Angeles.
- Feb. 10-12—Seventh Annual Solid State Conference, Philadelphia, Pa. (Sponsored by Institute of Radio Engineers, American Institute of Electrical Engineers, University of Pennsylvania).
- Mar. 10-11—National Flight Propulsion Meeting, Ambassador Hotel, Institute of the Aeronautical Sciences, Cleveland, Ohio.
- Apr. 8-9—Structural Design of Space Vehicles Conference, Sheraton Hotel, Santa Barbara, Calif. (Sponsored by American Rocket Society's Structures and Materials Committee).
- Apr. 6-6—1968 National Meeting "Hyper-Ferronuclear-Space Frontier," Institute of Aeronautical Sciences, Elmside Hotel, Los Angeles, Calif.
- Apr. 19-21—Interrelated Symposium on Atomic Networks and Fuel Cells Systems, Engineering Societies Bldg., New York, N. Y. (Sponsored by Institute of Radio Engineers, Department of Defense Research Agency, Institute of Radio Engineers).
- Apr. 28-22—National Symposium on Manned Space Stations, Institute of the Aeronautical Sciences, Ambassador Hotel, Los Angeles, Calif. (Co-sponsored by National Aeronautics and Space Administration, the Rand Corp.).
- Apr. 21-22—Seventh Metals & Materials Meeting, American Institute of Mining, Metallurgical and Petroleum Engineers, Ambassador Hotel, Los Angeles.
- Apr. 27-28—Ninth Meeting on Space Age Materials, Chemical Society Chapter of the American Society for Metals—Structure Division Hotel, Cincinnati, Ohio.

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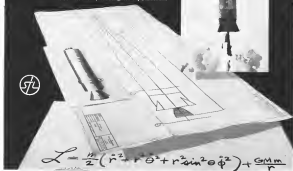
FROM LAGRANGIAN TO LIFT-OFF

Sometimes forgotten during the thundering ascent of a space probe rocket are months of meticulous analysis, engineering and planning. The staff of Space Technology Laboratories is now engaged in a broad program of space research for the Air Force, the National Aeronautics and Space Administration and the Advanced Research Projects Agency under the direction of the Air Force Ballistic Missile Division. For space probe projects STL provides the total concept approach, including preliminary analysis, sub-system development, design fabrication, testing, launch operations and data evaluation. The total task requires subtle original analysis in many fields as well as sound technical management.

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Meets new NAS 1291

SPS FN-12 Featherweight locknut replaces NAS 679 and equivalents*—saves up to 72% in locknut weight



SPS FN-12 Series Featherweight locknut was the first to meet new NAS 1291 calling for a lighter weight replacement for NAS 679 steel metal nuts. New design featherweight locknuts offer major weight savings, superior performance, high reliability, also permits secondary weight reductions through use of minimum locking flanges.

Here is one of the few nuts that parallel new NAS 1291 standard calling for a lighter weight locknut interchangeable with NAS 679 steel metal nuts. The new SPS FN-12 weighs 12.60g, less than its NAS 679 counterparts . . . and 12-72% less than equivalent MS or AN types. Yet it sacrifices none of the static or dynamic properties of these larger, heavier nuts. It provides 160,000 psi tensile strength on a 380,000 psi bolt and gives greater bolt-tension-tension fatigue strength than any other lightweight locknut tested.

The FN-12 saves weight *another* way also. Because of its new configuration, it can be installed closer to vertical submembers than any other aircraft nut now in use. This allows a narrower bolting design, with consequent reductions in aircraft weight.

You can specify FN-12 Series Featherweight locknuts in 11 sizes—#4 through 1/2 inch. All sizes are available for immediate delivery from \$4 to \$14. FN-12 locknut prices are presently the same as NAS 679 locknuts in the size range including 1/2 inch and above, prices are considerably lower.

For more information, write SPS—manufacturer of precision threaded fasteners and allied products in many details, including titanium. Request Bulletin 2426.

| ACTUAL WEIGHTS OF FN-12 AND COMPARABLE LOCKNUTS | | | | | |
|---|-------|---------|-----------------------|-----------|-------------------------|
| All Weights Expressed as Pounds per 1000 Pieces | | | | | |
| Size | FN-12 | NAS 679 | 5 Weight Series FN-12 | AN Series | % Weight Saved by FN-12 |
| #4-40 | 9.4 | 58.4-58 | 50% 40% 50% | 5.8 | 49% |
| #6-32 | 2.7 | 13.1-17 | 30% 40% 50% | 2.8 | 72% |
| #8-32 | 5.8 | 21.0-28 | 40% 50% 50% | 4.3 | 71% |
| #10-32 | 1.8 | 3.5-5.8 | 40% 40% 50% | 4.8 | 40% |
| #10-36 | 3.6 | 3.9-4.7 | 30% 40% 50% | 6.5 | 59% |
| #10-44 | 6.4 | 6.4-7.8 | 14% 30% 50% | 11.8 | 54% |
| #10-48 | 7.3 | 9.3 | 30% | 16.8 | 46% |
| #10-50 | 14.7 | 18.0 | 4% | 25.8 | 39% |
| #10-52 | 20.0 | — | — | 43.3 | 51% |
| #10-56 | 24.4 | — | — | 71.5 | 66% |
| #10-58 | 33.4 | — | — | 87.9 | 61% |

Range of locknuts normally used also meet new NAS 679 type. Drawn for AN 213, 214, 311.

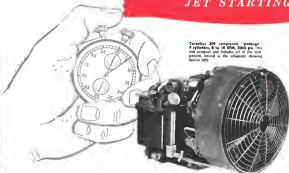
ANS 2204A, MS 2204A, NAS 3275, NAS 1032, AN 343, AN 344, AN 345 and AN 346.

AIRCRAFT/MISSILE Division

SPS

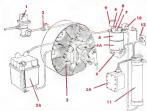
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...important news about
JET STARTING



Cornelius 309 compressor "package" 8 cylinders, 6 to 10 CFM. This package includes all of the components needed in the schematic drawing below left.

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The Cornelius 309 compressor "package" will soon be operational on five major domestic airlines and five major foreign airlines. It has also been selected for installation on the Allison Prop-Jet Super Constellation. This pneumatic system was developed to give jets better, faster starts. It is unmatched for reliability, capacity and longer life. It improves the performance of any jet or prop-jet equipped with a faster starting system.

Here are some facts that document Cornelius equipment superiority. The 309 compressor is the largest capacity compressor now in production and flying. Its 6 to 10 CFM air delivery is 50 per cent greater than any other available compressor. That larger CFM delivery means greater reliability and longer life because less "ON" time is required for air receiver recovery, is ideal for short flights.

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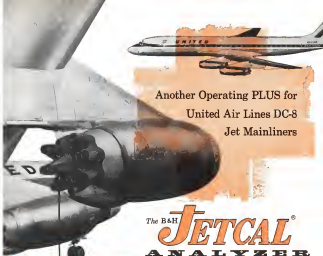
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Thoughts on Disarmament

Since the visit of Nikita Khrushchev to this country there has been considerable talk in Moscow and Washington of disarmament as a prelude to establishing lasting peace in the world. Genuine peace, of course, is an almost universal goal among people of all nations and governments. But, throughout our history as a nation, there have been times and places where we decided that the price of peace was too high to pay if we desired to survive as a free nation—at Lexington, Ft. Sumter, Pearl Harbor and the 38th parallel of Korea to name a few.

In the current diplomatic trend to look on self-disarmament as a panacea that will solve all world problems, it is worth taking time to recall one set of the more realistic questions raised by this sudden interest in disarmament by a nation that has devoted the last 15 years to one of the most extensive technical armament programs the world has ever seen and whose avowed aim is to bring all other countries of the world under the iron yoke of its political system.

Perhaps part of the answer lies in some of the domestic problems facing Mr. Khrushchev in the Soviet Union. According to the best available estimates, the USSR has been devoting about 40 to 45% of its gross national product to its defense industry, technology and armaments. This crushing economic burden has prevented any substantial improvement in the Soviet citizen's standard of living. Since the first holes were in the Iron Curtain after Stalin's death, the Soviet citizen has been getting more and more of an idea of how the rest of the world lives. This has generated tremendous domestic pressure for major improvements in the standard of living which can only be met by reductions in the Soviet armament program.

The expanding Soviet economy is also beginning to feel the pinch of labor shortages caused by the low birth rate during the terrible war years. Already the educational program has been shifted to pour more youths into the factories and farms sooner. Demobilization of several million infantrymen would also ease this increasing labor shortage.

Also, the Soviets either now have achieved or think they have achieved military parity with the United States. Hence, they feel they can negotiate from a position of strength rather than from their acknowledged position of military inferiority some five years ago.

Some economists studying the disarmament problem point out that, while the present Soviet program cuts away about 40% of its gross national product and is a severe limitation on expansion of its normal economy, the United States is supporting its defense program with only about 9% of its gross national product and without any strain on one of the most prosperous economies in the history of the world. They raise the question as to whether it is in the best interests of the United States to provide the Soviet Union with the economic breathing spell it so desperately needs or whether the best tactic would be to double our own defense program and set a

pace that it would be impossible for the Soviets to match. This would soon relegate them to a weaker position of acknowledged inferiority and make considerable stretch out of their current stiff posture.

There also is a tendency to look the cause of disarmament with economy and a general feeling that a disarmament program will eliminate a vast area of government spending and tax burden. Is this really a valid assumption? Do the people who have been studying the technical phases of the monitoring, reconnaissance and inspection systems required to militarily police any disarmament program feel that they deliver substantially from the costs of current defense programs? How much of a net economic gain is possible without sacrificing an effective control and surveillance system?

Another point that has been thrown into sharp focus by the recent independent actions of France in the Western bloc and China in the Communist bloc is how effective any disarmament agreement between the United States and the USSR would really be in enforcing world peace? Both France and China have indicated they are perfectly willing to defy the leaders of their respective political blocs and pursue independent nationalistic policies in regard to nuclear weapons and foreign aggression. Is a disarmament program that cannot effectively control the materials of any practical use?

Then, too, in the last analysis what really effective penalties can be enforced against a violator of a disarmament agreement short of actual war? We have seen a long history of disarmament pacts, attempts at economic sanctions, etc., in the decades between the two World Wars and the more recent postwar decade, but they seem to have had little effect until the use of force became the final effective policy. Is all this modern history of disarmament pacts, they have only served to provide a potential aggression with the nose pointed to build sufficient strength to violate the agreement with impunity, while the nations who abided by the agreement in good faith let their military power to enforce it dwindle away.

The cause of peace is certainly one of humanity's shining goals, and the motion impelling many world leaders to seek methods of effective disarmament are unquestionably sincere. But too many of us can still recall the triumphant arrival at Croydon Airport of a smiling British gentleman clutching an umbrella and waving a piece of paper which he announced he had brought from Munich to ensure "peace in our time." That, as we all remember, was just a year before the Nazis and Stukas ground Poland into the dust and forced free men everywhere to fight for their lives and countries for five bitter years. Before we become too firmly committed to any proposals aimed at reducing our military strength or that of our allies, we should make certain that some of these realistic considerations have been thoroughly appreciated. In the meantime, any unilateral move to diminish our military posture and to lower our defense guard would be sheer folly.

—Robert Hots

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WHO'S WHERE

In the Front Office

Mede Zisser, a director, Varian Associates, Palo Alto, Calif. Mr. Zisser is the company's vice president for sales.

Joseph K. Day, a director, Radio Engineering Laboratories, Inc., Long Island City, N. Y. a subsidiary of Dynamac Corporation of America. Mr. Day is a vice president of RFL.

Norman C. Fickinger, a director, Avco, Inc., Woodville, N. Y. Mr. Fickinger continues as vice president and technical director.

Marvin Haggett, vice president and general manager, Cook Electric Co.'s Technical Center, Matteson, Ill.

Robert F. Hollings, executive vice president and general manager, The Helmsboro Co., Chicago, Ill.

Albert J. Meyer, senior vice president engineering, Lewelling Electronic Products, Inc., Palo Alto, Calif., a subsidiary of Radiation, Inc. Also **Harry G. Head, chief engineer.**

George M. Elbert, vice president and general manager of the newly expanded Aeronut Division of Aeronautics Manufacturing Corp., Middletown, Ohio. The new division integrates Aeronut's facilities in Los Angeles and Cincinnati, Ohio.

John H. Mahoney, vice president of aerial testing services, Capital Airlines, Inc.

John Mahabon, vice president aerospace testing, Glavin Division at U. S. Industries, Inc., Chicago, Ill.

Joseph G. Deke, executive vice president for sales administration and public relations, Massachusetts Manufacturing Co., St. Paul, Minn. C. C. Marsh succeeds Mr. Deke as executive vice president for the Control Airplane, Advanced and Chemical Division. Also **J. F. Whelan, general manager, Control Airplane Division.**

Joe C. Peterson, assistant to the president, East, Inc., Los Angeles, Calif., to assist and coordinate special projects.

Ludwigson Clarence Aylward, Jr. succeeds Greg Shindler as general manager for North and Central America, supplying, Wolfgang A. Kibel who is now a member of the airline's boardman and chief executives.

Rear Adm. John S. Clark has received orders for duty in the Office of the Chief of Naval Operations. **John S. Clark** will relieve **Adm. Thach** as commander of Carrier Division 35.

Honors and Elections

Louis A. Frenn, director of traffic for Boeing Airline, has been elected chairman of the International Air Transport Association's Traffic Conference for 1959. **Joseph R. Bloomer, director of maintenance and engineering for Boeing, has been appointed chairman of the Air Transport Association's Engineering and Maintenance Conference for 1959.**

Wing Cmdr E. W. Anderson of Sperry Gyroscope Corp., Ltd., has been elected president of The Institute of Navigation, London, England.

(Continued on page 147)

INDUSTRY OBSERVER

► Project Titanus navigation satellite being handled by Navy for the Advanced Research Projects Agency is being designed to give Polaris submarines a position fix to an accuracy of one-half of a mile by the time the system becomes operational in the 1963-65 period. Special equipment will be acquired to determine the location with that accuracy, but only one vessel without this equipment will be able to fix position with one half mile accuracy.

► Rocket engine backup effort in USAF's Minuteman solid propellant ballistic missile program will be reviewed by the end of the year to determine the feasibility of using a single contractor for development of the second and third stage preassemblies. That at present is the only first stage contractor, Thiokol and Aerojet have parallel programs for the second stage, with each offering a different approach, and Aerojet has third stage development with a limited backup by Thiokol. Hercules Powder Co. research on double-burned propellants for the system probably will be continued.

► Research and analysis of a mobile ballistic missile system is being conducted by the Planning Research Corp., Los Angeles, for Air Force's Ballistic Missile Division. Scheduled for completion by the end of the year, the study is concerned with developing the operational solution ships concerning the military and economic value of mobility as a basic mode of operation.

► Prototype flight test of Aerojet's SD-1X surveillance drone is scheduled for February at Ames's Yuma, Ariz., site. The SD-1X, a follow-on version of the Boeing RB-55A, will be used as a follow-on surveillance and reconnaissance system to relay photographs directly to the ground rather than depend on film recovery. Drone speed of the recoverable vehicle will exceed 100 kts.

► Northrop's North Division is investigating a broad field of VTOL and STOVL combat and logistics-type aircraft in a company-headed study.

► Third-stage, 6,000-lb.-thrust solid-propellant rocket motor under development by Jet Propulsion Laboratory for National Aeronautics and Space Administration's Vega research vehicle has been fired successfully on two occasions from the Defense at Edwards AFB, Calif. Rocket motor uses hydrazine and nitrogen tetroxide.

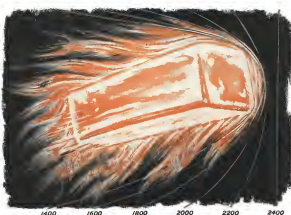
► Commanders of the Atlantic, Pacific and White Sands missile ranges met recently at USAF's Missile Test Center, Patrick AFB, Fla., to decide what support they will be able to offer NASA in the Pioneer Mercury man-in-space program. Range facilities for orbital Mercury flights will be coordinated in a watch-hour basis by Maj. Gen. Donald Yates, AFMTC commander (JAW Oct 5, p. 20).

► Special facilities are being erected at Palo Alto, Fla., by Radiation, Inc., for development of a high-accuracy pulse code modulated teletransmission system for testing North American Aviation's guidance system scheduled for Air Force's Minuteman II reconnaissance ballistic missile. Radiation is constructing the facilities under subcontract to Boeing Airplane Co., assembly and test contractor for Minuteman.

► Sparrow III missiles incorporating Thiokol storable liquid propellant (JAW Nov. 2, p. 14) are now being introduced to the fleet in limited quantities. Powerplant replacing the solid propellant originally designed for the missile, eventually will be used in virtually all operational versions of the Sparrow III.

► Altitude chamber testing of NASA's Mercury capsule contained environmental system has begun at Garrett Corp.'s Aerospace Division in Los Angeles.

► Commencement China has begun mass production of the single rotor Whirlwind 25 helicopter. The vehicle is a close copy of the Russian Mi-4s.



Bending the Heat Barrier



Speechcraft mold equipment is available in HAYNES STELLITE for making high temperature alloys into a variety of shapes and sizes. One (above) is being produced on a 56-inch mold.

High strength plus resistance to oxidation, creep, thermal shock, and fatigue are some of the properties that have helped to push the heat barrier back over the past 15 years. These are the properties found in Haynes high-temperature alloys. Properties that make these alloys very useful in the 1000 to 2600+ deg. F. range.

Typical uses? The really hot spots in jet aircraft, engines, and missiles are some. Furnace components, heat-treating equipment, kiln liners are others. In fact, any part where long service life under severe high-temperature conditions is essential.

There are 12 Haynes high-temperature alloys—available immediately in convenient forms that can be readily fabricated. For information on properties and prices, write for descriptive literature.

HAYNES
ALLOYS

HAYNES STELLITE COMPANY
Division of Union Carbide Corporation
Kilbuck, Indiana



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Washington Roundup

Space Budget Boost

Watch for a substantial increase in the Fiscal 1961 budget for the national space research program to be proposed to Congress by President Eisenhower. Two proposals of the series of successful Soviet moon probes and a dogged fight by top leaders of the National Aeronautics and Space Administration have convinced the White House and Budget Bureau of the need for adequate funding of the expanding U.S. technical capability in space research and the necessity for attempting to gain world leadership in this area. NASA budget for Fiscal 1960 was \$500,780,000 after congressional cuts. Budget to be proposed to Congress for Fiscal 1961 probably will be close to \$800 million.

Fairchild Stock Activity

Financial circles are excited about heavy acquisitions of Fairchild Engine & Airplane Corp. stock in Washington lawyer C. Leo DeOnofre. DeOnofre joined the Fairchild board last March after he acquired 15,000 shares. Securities and Exchange Commission reports late this summer showed his holdings had risen to 35,000 shares, and, in the last few weeks, his holdings have grown to 68,000 shares. The only other large individual stockholder is Board Chairman Sherman Fairchild, who last spring held 198,559 shares. Speculation is that DeOnofre is acting for entrepreneur Arthur Godfrey, whom he has represented previously.

Last week, Fairchild turned up on the most active list of stocks traded on the New York Stock Exchange with a turnover of 27,306 shares in one day, and the stock had gained \$1 in price.

U. S.-Canadian Meeting

Details of shipping and storing nuclear warheads in Canada under joint U.S.-Canadian control was discussed last week at a bilateral-level meeting between representatives of the two countries. Warheads will be available in 1961 for use in Canadian/United States Bomarc defense missiles.

Discussions also covered disarmament and a further strengthening of the defense sharing policy which was agreed about six months ago. Under this policy, Canadian purchases of defense equipment in the U.S. would be balanced dollar-for-dollar by U.S. buying in Canada. To strengthen the present loose arrangement, the Canadian made a specific proposal that U.S. firms receiving orders for Canadian Bomarc equipment sign a contract agreeing to buy goods of equal value from Canadian firms.

ALPA Seeks Age Limit Hearing

In a move to force a hearing on proposals to impose age limits on pilots, Air Line Pilots Assn. last week asked the Federal Aviation Agency to "meet in their entirety" the proposed rules. ALPA, now convinced that evidence to support the ruling is lacking, feels that a hearing would force FAA to drop the age proposals. In a step toward obtaining such proceedings, ALPA has submitted to FAA its supplementary recommendations for rejection of the rule. In its initial arguments regarding the recommendations for rejection, ALPA reasoned that "it is mandatory that it, even in the face of obvious lack of evidence, there is any intention of proceeding any further with

the FAA proposals, as exorbitant proceeding be established in which any facts in connection with these proposals may be fully developed."

Khrushchev Lays Out Soviet Science

Soviet Premier Nikita Khrushchev outlined Russian enthusiasm for the nation's scientific achievements in the hemisphere speech before a recent session of the Supreme Soviet as reported in the Soviet press.

"These days, our wonderful scientists have made another wonderful gift to our motherland. They paid good credit to the moon and the revealed them with facts, allowing them to photograph the side which the [Soviet] had in the left secret from the right of man. [Applause continues.] We are truly proud of the Soviet scientists who presented the moon to lift her veil, a witness of the past. [Applause.] Under the influence of Soviet science and culture, the moon discarded her veil, began to go in step with our time, and revealed her face to Soviet scientists and to the Soviet people. They made it possible for the whole world to acquaint itself with the secret secrets of this celestial beauty, but of course only with the moon's permission, because we are not Propping Forces. [Applause.]"

"Permit me from this lofty rostrum to warmly congratulate our astronomers for this wonderful scientific feat, on the name of the Soviet government, the Supreme Soviet, and the CPSU Central Committee. [Long applause.] Permit me to wish them new successes, discoveries and similar brilliant achievements to the glory of our great country, victorious communism, in the name of the triumph of peace on earth. [Long applause.]"

Electronic Research Increase

Electronic Command and Control Systems, such as Strategic Air Command Control System (465L) and Intelligence Data Handling System (478L), now represent a substantial part of the total Air Force research and development spending. The Air Force is spending \$1 billion of dollars, Big Gen. D. E. Newton, Jr., told a recent meeting of the Armed Forces Communications and Electronics Assn. The Air Research and Development Command chief of staff said the number of such systems is growing. Air Force will send out requests for industry proposals on new hardened Naval Coastal Operations Center (225L) this month. Next aviation program to be launched is expected to be the Pentagon Command Post (475L).

Queens on Tour

Federal Aviation Agency Administrator E. R. Quisenberry last week on an around-the-world evolution and study trip that will take him to Russia, Afghanistan and eight countries in the Far East. Purpose of the trip, which is being sponsored by the International Cooperation Administration, is to check FAA facilities, airways and air traffic control operations and evaluate FAA technical assistance programs which are conducted with ICA funds. The itinerary includes a two-day stay in Moscow where Quisenberry will discuss "aviation problems" with the embassy officials. He will return to Washington Dec. 5 after a stopover in London on the flight from Moscow to the U.S.

—Washington staff

Defense Employment Practices To Be Probed by Congress Unit

Washington—Appointments of Dr. Charles L. Critchfield to run Defense Department's Advanced Research Projects Agency, which is slated to lead by orders (AWW Nov. 9, p. 25) will result in a close congressional examination of Defense Department's employment policies.

Rep. Bob Hoffeld (D-Calif.), chairman of the House Military Operations Subcommittee, has asked his staff to look into various aspects of the appointment to determine the merits of action to be taken by the subcommittee after Congress reconvenes in January. Dr. Critchfield's new job is not subject to congressional confirmation.

Hoffeld made it clear that the legitimacy of the appointment was not being questioned, but that terms and conditions of the appointment would be thoroughly read because of the possible implications involved. The appointment was made on the basis of a provision in the Second Supplemental Appropriations Act of 1955 which was included as an emergency measure to help the government obtain consultants without compensation.

This law gives the Defense Department authority to appoint up to 10 persons as consultants who would be compensated from the Department's internal statistics and would not be required to sever connections with private industry.

Defense Department said that Dr. Critchfield would retain his \$19,000-a-year position as director of research activities for the General Dynamics General Dynamics Corp. and move into the \$19,000-a-year ARPA post that week, serving without compensation. He is scheduled to replace Ken W. Johnson, who has served as ARPA director since his inception last year.

There was speculation in Washington, however, that Critchfield may make a last minute decision to refuse the post because of criticism of the appointment which began here on the payroll of Congress, a firm heavily involved in defense work supervised by ARPA, and the disadvantages in which it would place his company. Under the appointment, Critchfield would have to sever contact with defense contracts involving Congress.

Hoffeld said he questioned the wisdom of borrowing a man from a company working on government contracts to lead on affairs affecting contractors' access to military funds.

Subcommittee staff will the inquiry probably will cover more than Dr. Critchfield's appointment and will go

into the entire Defense employment picture, including questions of how procedures to advance the line are adopted, how the line are enforced and who has been employed under these procedures.

The subcommittee suggested earlier this year that more attention be focused on Defense Department employment practices during hearings on organization and management of atomic program (AWW Mar. 23, p. 34). At that time, the subcommittee questioned the ARPA contract with the Institute for Defense Analysis, a nonprofit organization, to provide professional personnel under somewhat different arrangements than those under which the Critchfield appointment was made.

Under the IDA arrangement, professional personnel are given levels of clearance from their companies and receive their compensation from IDA while staffing ARPA positions. The subcommittee report said the situation

created a difficult and delicate situation. "As the Defense Department agency controlling the major funds for advanced research," the report said, "it incites intense curiosity from industrial firms and an understandable desire to have a direct pipeline to the major activity. The risk is not so much that obtaining of immediate contracts but of getting valuable information for future business opportunities."

In addition to IDA employees, those serving on the Defense Department and during cooperation from outside the government are:

- John M. Spague, acting assistant secretary of defense (comptroller), vice president of the Carter Oil Co.
- John R. Townsend, general consultant for fuels and materials, Research and Development Office, who is employed by Bell Telephone Laboratories.
- Hector Stiller, assistant director for air defense, Research and Development Office, who is president of Aerometric Instrument Laboratories.
- Edwin Paxon, assistant director for tactical weapons, Research and Development Office, who is employed by Rand Corp.

Rocket Records Electron Density

Washington—Aerjet fired a Strongman research rocket to an altitude of 1,070 feet last week. It was the first test flight in the upper atmosphere. Launch was one of a series in the U.S. program for international geophysical cooperation.

Flown in cooperation with the National Aeronautics and Space Administration, Strongman reached the highest altitude ever recorded at NASA's Wallops Station before falling into the Atlantic Ocean about 600 mi. from its launch.

Rocket was launched to obtain data on the decrease in ionization at altitudes of up to 1,000 mi. Above is referred to in this data because of its relation to the environment in which international ballistic missiles and anti-ICBMs will operate.

Rocket and payload were developed and assembled by the University of Michigan Research Institute under contract to the Army Ballistic Research Laboratories. Rocket began with a transmitter developed by the Michigan group which broadcast on 37 and 145 mc. Measurement of ground stations of the difference in phase of the two signals permit calculation of electron density in the atmosphere through which the signal is transmitted.

Strongman rocket was 56-45 ft. long and weighed 7,175 lb. at launch. First three stages were on Howard John and

two Nike Apis boosters. Fourth stage was a Thorbird, which is a thorium burning version of the Thor. The third stage was a one fifth scale Sergeant. Strongman is similar to the Jason rocket but has higher performance in the last two stages.

Rocket burned out at about 17,250 ft. per second at the end of the third stage and 130,000 ft. and continued in its peak altitude. It was aerodynamically stabilized, and the fiber glass nose cone and attached 616 ft. stage were coated with Teflon to protect them from aerodynamic heating. First-stage interstage was mounted flush under the fiber glass in the nose cone, and a thermometer indicated that temperature was held to 160°C at the interface between the fiber glass and the ablating Teflon Douglas Aircraft Co. fabricated the nose cone and coated it and the fifth stage rocket case with Teflon.

Strongman payload was tracked from Wallops Station from Aberdeen Proving Ground and from the Michigan Radio Station at the Massachusetts Institute of Technology. Data will be available to all nations participating in the continuation of the International Geophysical Year effort. A second Strongman shot is scheduled to be made next spring, later this summer. Data will be compared with data launch results to explain the sun's effect on the ionosphere.



Glider and biplanes cover most of the main parking area at Baden-Baden, in preparation for international meet.

German Aero Club Organizes International Meet

First international cooperation of sport and touring aircraft was organized by the German Aero Club. Participants had to be members of any national club belonging to the Federation Aeronautique Internationale. The event was modeled off with a three-day rally at Baden-Baden, Germany, where gold and silver medals were awarded the winners. Purpose was to establish whether there still is enough interest among private pilots to enable them to enter for a meeting requiring days of intense flying on the lines of serious biplane fights and rallies, or whether they prefer to take the shorter route in order to pass the international meeting. Strongman contingent at all three groups of 70 aircraft which completed the meet at Baden-Baden were the American lightplanes such as the Cessna 170A, 170B, 175, 182 and 180C.

The Beechcraft G50, Beech Bonanza RV5 and G15, and Piper PA-24, PA-22, Piper Tri-Pacer and Piper PA-18 types. Rudolf Kuttel flying a two-seat RV5 aircraft which is powered by a 65 hp. French engine, was awarded the silver medal. With this machine he landed 50 times in 6 different countries. Three points were awarded for each stop made at or within 100 miles in the country where the aircraft is registered; 25 points for each foreign country where a landing was made during the flight and six points for each separate landing made in a foreign country. The Beech Squares fly the entire route of the competition. The squares are scored after five (Dr.) Franz Riedel, one of the biggest supporters of private flying in Germany, and head of Bielefeld-Dresch and Vertig-GmbH, (publishers), of Offenbach.



Two-seat RV5 was flown by pilot Rudolph Kuttel (in cockpit) to win silver medal, at right is Beech Squares formation.

Soviets Improve Computer Technology

By Philip J. Klaus

Washington—Soviet computer technology is advancing rapidly but appears to lag a year or more behind U.S. computer technology in this aspect of several members of an eight-man team of U.S. experts who spent 10 days visiting Soviet computer facilities and facilities.

However, several team members, who reported these observations here at a seminar sponsored by the Office of Naval Research, speculated that the Russians may not have disclosed all of their latest computer developments and techniques.

The Soviets appear to follow a firm policy of "let us see," showing the U.S. team facilities which correspond to those seen by a team of Soviet experts who visited the U.S. earlier. Because of military security, the Russians were not able to visit certain U.S. computer manufacturing facilities.

Following are some of the observations on Soviet computer technology reported during the ONR seminar:

- **High-speed magnetic tape transports for computer input/output** are expected to lag considerably behind U.S. developments. Several Russian computers use punched magnetic film with eight data storage tracks, which provides 75 words per second. This is comparable in speed to punched tape used in the

U.S. but considerably slower than U.S. magnetic tape input/output equipment.

- **No stored access boards** were seen in any of the Soviet computers. The Russians, however, do make widespread use of program control modules in their computer construction.

- **Machined translation of foreign languages** is being pushed hard by the Soviet Union. Progress appears to be more cooperative, better organized than the U.S. effort. Present efforts are directed toward translation of English, German, Japanese and Chinese into Russian.

- **Deposited thin magnetic films**, among the newest techniques in the U.S., are being actively investigated by the Russians. Best results have been obtained using an 80/20 percent by weight film thickness of about 2,000 angstroms. The Soviets say they hope to obtain switching times of 20 to 50 nsec microseconds but are having difficulty in achieving uniform film characteristics.

- **Computer manufacturing techniques** employed at the Soviet computer factory in Pskov appear to be every bit as modern as those in use in this country.

- **Magnetic drums** used as memory devices in Soviet computers achieve storage density of about 100 bits per inch, comparable to that achieved in the U.S. Russians use a one and one-half inch drum and read-write heads. Heads are

prelocated before data is stored to maintain a clearance between the drum and head when the drum expands due to internal heating.

- **Deposited carbon resistors** are used extensively, even when precision resistors are not required. Clear plastic encapsulation is that fabrication of deposited carbon resistors is a more costly method not than that of producing cheaper composition resistors.

- **Small desk-size analog computers**, which appeared to be the equal of anything available in the U.S., were in widespread use in laboratories visited by the U.S. team.

- **Computer scientists** keep abreast of the latest computer developments in the U.S. and elsewhere through USSR's rapid translation and distribution service. "They seem to sit in libraries in both complete and assembly lots," Dr. Martin Rubenstein, University of Pennsylvania, told the seminar.

- **Automatic programming of computers**, under study for several years in the USSR, does not appear to have aroused too much enthusiasm among Soviet computer scientists.

- **Transistors, diode-laser tubes**, capable of operating at frequencies up to 170 mc were shown to U.S. visitors. Russians, however, appear to be having trouble fabricating transistors with uniform characteristics. In a group of trans-

istors which have an average Beta (gain) of 50, the figure for individual units in the group frequently range from as low as 10 to as high as 250, a considerably greater spread than found in U.S. transistors. The Russians say they are producing transistors for communications equipment use that can operate at frequencies as high as 400 mc.

- **New high-speed printer** capable of printing 50 lines per second is now under development. The machine, while considerably faster than any U.S. printer, is limited to numbers and does not print letters. Machine stores up to 10 lines at a time, prints them all simultaneously.

American visitors were shown a number of Soviet computers now in production or in use, several now computers in the prototype stage plus several in development.

- **Reason B.** One of the first large Russian digital computers, this machine originally had an acoustic memory, later changed to cathode ray tube storage and, still more recently, to ferrite core storage. This computer, which can perform an average of 3,000 operations per second, is roughly comparable in speed to the IBM 704.

- **Reason D.** Improved version of the earlier model, with approximately the same speed, is in the prototype stage.

- **Unit I.** Small digital computer which operates at the relatively slow speed of about 100 operations per second is in widespread use in the Soviet Union and has been exported in small numbers to India, China and Poland. More than 150 of these machines have been manufactured.

- **Unit B.** Advanced version of the earlier model, with much higher speed (5,000 operations per second), and with more advanced organization. Magnetic drum is used instead of the redundant current magnetic core memory employed in Unit I.

- **Unit C.** This computer is believed to have been produced in several models. Its speed is about 2,000 operations per second.

- **M-26.** A new very high-speed computer now under development, which apparently will have capability of 20,000 operations per second. This makes the computer comparable to the IBM No. 7 computer produced several years ago for the Naval Ordnance Laboratory.

- **New An** microcomputer machine with a speed of about 6,000 operations per second.

Other Soviet computer developments which were discussed but not seen by the U.S. team included the Lera 1 recently described in Russian literature, with its magnetic elements predominantly in the form of thin films, a new diode-based microcomputer, and the Angart.



Mercury Recovery Test

Now being shipboard Mercury recovery tanks from the Atlantic Ocean five miles offshore from National Association and Space Administration's Wallops, Va., Station. Endurance tanks was launched as a test of the ship's recovery system under emergency conditions (AW Nov. 6, p. 29). Capable of carrying animals will be used later.



Russians claimed that they are using the Reason 1 computer to forecast weather in the northern hemisphere. The Smol is being used for lunar programming studies. One of these involves the calculation of the best distribution and inventory of wind in the vicinity of Moscow for the city's widespread construction. Said is distributed from eight supply points to several hundred points of use.

The four U.S. scientists who reported their observations at the ONR seminar included Prof. Harry B. Coole,

University of Michigan; Dr. Martin Rubenstein, University of Pennsylvania; Dr. Samuel N. Alexander, National Bureau of Standards; and Dr. Leif Rosen, New York University. Their observations included the facilities of Precision Mechanics and Computing Techniques in Moscow, the Moscow Computing Center, Moscow University, the Institute of Telecommunications and Mechanics, the Leningrad University Computing Center and a Soviet computer manufacturing facility at Pskov, southeast of Moscow.



Cessna Delivers First T-37B to Air Force

USAF's first Cessna T-37B intermediate trainer is powered by two Continental J69T-21 turbojet engines rated at 1,025 hp, thrust each. Three engines (upwards) the J69T-21, rated at 920 hp, thrust each, which power the J-73A. Other changes on installation of Collins AN-1000-34 VHF communications, Collins VOR-101 VHF navigation, including VOR-101 receiver, and VOR-101 VOR/DME instrument. Two engines. An AN-1000-34 VHF receiver has been modified to increase effective range from the aircraft. An AN-1000-34 VHF receiver will receive retrofit kits developed by Cessna and Continental for converting J69T-21 to J69T-21.



JOHN HARRIS at top of photo shows the path the North American X-15 research plane took during emergency landing.

North American Studies X-15 Damage

Edwards AFB, Calif.—Failure of fuel nozzles at a point just aft of the auxiliary power unit bay, where forward and center sections of the fuselage are attached, was the apparent cause of the North American X-15 autoland which appeared to be a broken back after a recent emergency landing (AW Nov. 9, p. 54). The plane will be repaired.

Phone and chase pilot reports by Maj. Robert White, USAF pilot who will fly the X-15 and who flew alongside test pilot Scott Crossfield and the X-15 during the landing, indicate that Crossfield made an overdue landing, so that the landing apparently was not the cause of the failure.

However, whether the failure was

have started in the air as a result of the explosion on one of the two ALR-11 rocket engines which power this research plane, with the landing impact serving to aggravate the failure, had not yet been determined.

While there was no estimate of the cost of the damage sustained, it was estimated that the airplane's structure could be repaired within five weeks. Some of the manufacturing techniques which originally worked in the X-15 may have been brought back from projects to which they had been transferred when the last of the three X-15 vehicles were finished some weeks ago.

Biggest concern in the incident has been over the cause of the engine ex-

pllosion and fire. Although Crossfield reportedly barely felt the explosion, chase pilot White said he had seen it. The last recorded seconds after the rocket ship was dropped from the Boeing B-52 mother ship.

Engine from the plane, the No. 2 second, had been sent back to the procedure bench at Air Force Flight Test Center base, while the airplane was trucked back to North American's Los Angeles plant for examination and repair.

There has been disassembly and the liquid oxygen tank, just aft the wing, point where the failure took, is undergoing inspection for rupture and other damage. Also being checked is

the plane's bleed air in this area.

There were reports that paratrools at all the liquid oxygen was jetted out when Crossfield dumped parachutes after the red fire warning light showed after the explosion. Opinion differs as to whether weight of the remaining liquid oxygen now have reflected the structural bending.

During the descent, Crossfield determined that the control system functioned normally and had not been damaged by the explosion, even though the lines run approximately through the center of the fuselage. Throughout the approach, the aircraft continued to respond normally to control and Crossfield elected not to land, rather than shroud the research vehicle.

North American spokesmen could not immediately explain why the fast-landing, although the landing was normal, according to Crossfield. It was pointed out, however, that this was the last time the X-15 had been loaded after dumping fuel rather than landing. It considerably more stress might have been placed on the structure because of the added weight of remaining propellants. Increasing the fuel load, according to North American, does not as completely expend the propellant as does consuming them in the engines.

After complete disassembly and investigation and after preventive measures are taken, the research program will continue. Horton Stinson, project engineer, said, "we will continue our program with the No. 3 X-15 as soon as we determine the nature of the accident."

Remains of the X-15, second of three aircraft, was turned by North American as "not recoverable."

Thiokol Wins Contract For Spherical Rocket

Washington — Thiokol Chemical Corp. has a \$50,000 contract to develop and produce solid propellant spherical rocket motors for National Aeronautics and Space Administration research program.

Thiokol will develop and produce spherical motors based on the 5 in. motor developed by NASA for use in its satellite re-entry recovery rocket (AW Oct. 26, p. 50). The spherical motor is the last stage and is fired downward into the atmosphere at re-entry apogee. Thiokol motor will be considerably larger than the NASA motor on which it is based.

NASA also has awarded a \$10,000 contract to Minneapolis-Honeywell Regulator Co. for fabrication of a guidance and control system for the Scout vehicle and a \$50,000 contract to Avon Division of ACF Industries, Inc.,

Russian Records

Moreover, eight per cent altitude at perigee—about 300 mi. at last mark by Russian aircraft, including a lift of 35 mi. to a height of 13,000 meters (42,600 ft.), the Soviet record.

The aircraft which carried the SF-500 was a four-engine turboprop aircraft designated 103M. The Soviet set the previous record set by a KC-135 which carried 38,889 lb. to an altitude of 6,400 ft. on Sept. 24, 1958, at Cape Canaveral, Fla.

Another Soviet four-engine turboprop designated 103M set a new record Oct. 30 when it flew a 3,000 km course (3,614 mi.) with a 27-ton payload at an average speed of 610 mph, the Soviet said.

This flight, at 7,000 meters (22,967 ft.) altitude, the Soviet set, broke speed records with payloads of 1, 2, 5, 10 and 25 tons and set two "altitude new" records, speed with payloads of 20 and 25 tons.

Data on the two flights is being forwarded to Federation Aeronautique Internationale for registration.

for Soviet aerial tracking lessons. Other contracts awarded in September:

- University of Michigan, \$50,000, basic research on the planning system that occurs under high temperatures in certain rocket engines.

- General Electric Corp., of America, \$10,000, instrumentation to measure electron density in the ionosphere.

- Pratt & Whitney Division, United Aircraft Corp., \$100,000, investigate heat transfer possibilities of a number of materials in a case reaction under high temperatures that would be encountered in a nuclear-electric generating system.

- Society of Photographic Scientists and Engineers, \$5,000, operational equipment for submarine photo and radio tracking of earth satellites.

- Republic Aviation Corp., \$75,000, check of laser and interferometer space probe trajectories.

- Bechtel-Rohr Division, Bechtel-Astin Corp., \$3 million, operation of Minuteman stations for 1960.

- Instituto Geofísico de Mexico, \$110,000, operation of tracking and receiving station at La Paz, Peru.

Discoverer Failure Caused by Inverter

Vandenberg AFB, Calif.—Recent attempt to effect insertion of Discoverer VII capsule from its opening second stage resulted from faulty electrical component although all other phases of the launching were successful.

Discoverer Two-launched Discoverer VII satellite (second stage Bell Rocket engine plus re-entry body) was first launched by Atlas airframe (Rockwell and Northrup) on Oct. 29 after launching, as the satellite oriented with an apogee of 518 stat. mi. and perigee of 103 stat. mi. Orbit time was 94.6 min.

Communications continued to be maintained, all stations receiving telemetry. However, after the third orbit, fluctuations of the beacon signal indicated that the satellite was in a slow tumble, perhaps three times per minute. According to telemetry signals, the satellite's inverter was not functioning.

This was supplies power to the attitude sensor sending signals to the penultimate control system which stabilizes the satellite. The inverter also provides power which operates the separation sequence (reentry vehicle from second stage).

After the recovery crew on second launch were alerted through the 17th pass on the chance that the inverter might act in again to effect separation, but no telemetry or beacon signal of satellite was received. The next second stage now is in orbit and is expected to remain there until Nov. 23.

This was the fifth previous polar orbit attempt with Discoverer out of seven flights. The cause of the malfunction in the satellite system occurred, as distinguished from the capsule system located in the re-entry body.

New Martin Division Prepares Titan Bases

Denver—Recently organized Martin Co. Activation Division will have personnel in the field to prepare facilities for Air Force's Titan ICBM weapon system.

Activation Division is managing and integrating the efforts of Titan system subcontractors who are providing equipment and facilities for Titan launch and operational launch bases. The new division, formed last June, is responsible for having the facilities completed when the Titan is ready to be activated in the field. Titan being developed here by the Martin Division.

Current work involves managing construction projects at the Vandenberg AFB training base and the initial operational site here at Love's AFB. Work is scheduled to start this fall on launch sites at Minotaur, Home AFB, Idaho, Ellsworth AFB, S. D.; Barks AFB, Calif.; and Larson AFB, Wash.

Martin is developing and producing the Titan at its Denver Division, and establishment of permanent headquarters for the Activation Division here. Keeps the company's Titan program efforts concentrated on the production and initial operational sites.

FIRE GUARDS stand study in North American technicians suspect damaged fuselage shortly after the landing.



Structural Beefup Distinguishes F-104G

Bethesda, Md.—Lockheed F-104Gs ordered by West Germany will be structurally beefed-up versions of the F-104D line being sold to USAF's Tactical Air Command. In addition to the structural strengthening, which will permit the aircraft to fulfill the low-level part of its mission capability, the F-104G will have a fire control system with a wider range of capabilities than the system on the F-104D.

The Canadian F-104s on order probably will follow the G-model format in a number of areas (AW No. 9, p. 18). The F-104G lightweight expert requires severely reduced weight, but is structurally the same as the F-104D, but the equipment differs. However, the equipment of the G are optional on the A, and a customer can have an F-104G with the F-104D capabilities.

For the high speed, low altitude mission, 35 new fittings have been provided for fuselage main frames, wing fittings and booms, fuselage hinges and joints, fuselage tail frame, engine pylon and air intake, plus some fuselage skin. In this condition, the F-104G is to meet strength requirements with full external loads for the fighter-bomber role.

Several changes have been made in the tail group, a modification has been made on horizontal stabilizer servo-mechanisms for increased hinge moment, the vertical tail has increased the overall area by 15% (this has appeared on the F-104B), the tail fin is improved and provides both yaw directional and directional control with a single surface as does horizontal stabilizer and aileron, eliminating a separate yaw damper servo.

Additional performance margin with takeoff flap setting has been determined

for the F-104G and, consequently, the available load factor is increased for the ground attack mission, and a decrease in turn radius at low level also is achieved.

Drag chute for the F-104G is 18-ft diameter, 2 ft larger than the 16-ft chute used by the USAF F-104C. Other differences are on an scoop leading edge and inlet ramp and king pin electrical clearance.

An increase of 120 gal in internal fuel can be accomplished on F-104G by installing special aluminum tanks in the spaces for the rapid fire cannon ammunition and the center fuel tanks and gun installation are interchangeable.

For armament, two Sidewinder heat seeking missiles, in addition to two on the wings, double the air-to-air combat capability. The two fully automatic shot can be carried in combination with pilot and wingtip fuel tanks for increased range interception missions.

A four track tracking autopilot is incorporated which includes altitude holding, and Mach holds plus a constant \pm lateral and yaw. The autopilot will give its inputs from the central air data system.

The control system will be North American Aviation Autotronics Division's NASARR, a radio and fire control computer. Sensors operate in atmospheric mode for heading and navigation, air-to-air for target interception and also is capable of providing data link information to other.

NASARR is connected to a director type, program which gives pilot an optical indication of line-of-sight with proper lead angle for firing the M61 gun. In the target or lead condition the sight is used as an aiming reference which brings Sidewinder missiles on by visual line heading attack. When used with infrared aiming, the sight can be used at night. A new infrared sight is being developed for daylight visual use which is compatible and integrated with the director sight in the use of camera optics and will have improved detection range.

Beam computer used in the F-104G ties in with the inertial navigators, air data system and NASARR and makes use of relationship between beam trajectory and attitude in space to compute bomb release at proper point in space. Four modes are included, dive tow, LABS, over-the-shoulder, and level flight.

All data computer gets analog from pitot and static pressure, air temperature and angle of attack from static transducers and transforms data into a form usable for readouts for the pilot and computers in the aircraft.

A small, lightweight automatic navigation device called PH1 (position and heading indicator), developed by Computing Devices of Canada, is installed which works on dead reckoning principles, computing where it is by remembering where it started and keeping track of all course and speed changes. Pilot has a choice of five destinations and distance by graduation. Indicator shows him the proper course to fly to get to the destination he selects, and also distance to go in nautical miles. No maps or charts are needed. Tatin also is programmed for installation in the F-104G.

In addition, the F-104G incorporates a lightsight, fully automatic inertial navigation system which requires no external support and does not emit any electromagnetic radiation. It measures visual ground distance and track and is not dependent on forward or computer words.

Japan Picks F-104

Tokyo—Final decision on a \$180 million program for the production of approximately 200 Lockheed F-104G jet fighters as Japan opens armament.

Selection of the Lockheed aircraft as the backbone of Japan's air defense was made by a Japanese Defense Agency mission, headed by Gen. Masao Goto, one for U.S. competition (AW Nov. 9, p. 21). It has been approved by Japan's Defense Council and announced in Tokyo. The U.S. Defense Department's Office of International Security Affairs is awaiting the submission of a formal proposal by Japan.

Competing aircraft evaluated by the Goto mission during a U.S. tour in August were the North American F-100, General Dynamics F-105, Grumman F-119B and the Northrop F-5B.

The program is approved by the Senate panel, which contains a third of the votes in the Diet. Appropriation to implement the F-104G program is subject to approval by the Diet. Details of potential financing by the U.S. under the mutual security program are to be worked out. U.S. is understood to be willing to put in between \$75 and \$100 million.

The Lockheed F-104 also has been selected by the Japanese Government and West Germany and will be produced in the two countries. Canada's jet F-104 is due all the assembly line in April, 1965. West Germany's is October, 1961. Belgium and the Netherlands have shown an interest in other than purchasing F-104s, or a program for production.

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B-58 Conversions

Washington—Lockheed will convert 13 of the 10 B-58 bomber built for light test to operational configurations. They will be assigned to USAF squadron units.

Five of the 10 test aircraft have been left in ground and flight conditions, and of the remaining dozen, four will be converted to pilot trainer with dual controls applying the dual-control equipment in the second cockpit, two are being modified to carry the F105 fire control and weapon data and will be used as the development of this system, five will continue on flight test status, and one destroyed engine will eventually be destroyed in static and dynamic structural tests.

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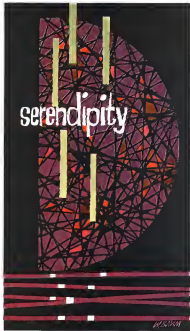
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NASA Issues New Regulations On Space Act Patent Waivers

By Craig Lewis

Washington—National Aeronautics and Space Administration has modified and clarified regulations governing patent waivers under the Space Act, but more basic changes in NASA's controversial patent authority will have to wait for congressional action next year.

New regulations clarify the conditions eligible for waivers and the conditions and procedures under which NASA will waive title to inventions. Generally, the regulations rule out waivers on inventions that have significant utility in space applications.

First waivers to be issued under the patent provisions of the Space Act went to Pratt & Whitney Aircraft Division of United Aircraft Corp. When concerned 13 inventions involved in sub-orbital engine development work Pratt & Whitney is doing under Air Force contract and which NASA is funding.

Generally, the Space Act says NASA agrees to use its patents in discovery made in the course of work under a NASA contract when the inventor is assigned to work supported by NASA or when the invention is related to work under a NASA project.

Industry has strongly objected to these patent right limitations, and NASA is expected to propose a change in the law that would provide discretionary authority similar to that of the National Science Foundation (NSF, Aug. 24, p. 16). Such authority would make clear the need to protect the public interest but would allow NASA to decide how to do it. This would permit NASA to make its patent policy more compatible with Defense Department policy and give industry a more consistent pattern under which to work.

Waiver provisions were added to the Space Act by Congress to meet some of the objections to the patent section. In recent regulations governing waivers were issued last March. Since then, however, laws have been held and comments have been received from industry and the Aerospace Patent Bar. Now changes have been made based on these comments plus NASA's experience with the regulations since they were first issued.

New regulations apply to all inventions conceived or first actually reduced to a practical state under the NASA contract conditions which give the U.S. title to them. NASA policy states that waivers will be considered in the public interest when joint ownership of patent rights will stimulate early development of an invention to a practical state or where "substantial equities"

justify retaining the private rights.

NASA has barred inventions relating significantly to space technology from waiver eligibility. Included in this category are inventions primarily related to development and operation of manned or unmanned vehicles capable of sustained flight without the support of the atmosphere and inventions which are of basic importance in research on problems related to these space vehicles. NASA also will refuse waivers on inventions relating to fiber-optic or optical radar material unless the Atomic Energy Commission approves such a waiver.

For inventions not included under that ban, the patent will have a primary use for a service in an exclusive location where the invention has a predominantly commercial value or when a company has made a much larger investment in support of the research producing the invention than NASA.

Another major factor case for a waiver is an invention that was conceived and submitted for a patent before NASA issued a contract, but which was first reduced to a practical state with NASA funds. Also included is an invention that was conceived or first reduced to practice under a contract with a university or non-profit research organization which concentrates on scientific research, provided the contract does not call for delivery of models or equipment or the development of practical processes.

NASA will waive its rights to an invention in countries outside the U.S. when the agency decides not to apply for a patent on the invention in the countries involved.

With all these waivers, NASA retains the right to sue an inventor, nontransferable, royalty-free license for the practice of an invention throughout the world after the U.S. is its agent as by any foreign government in line with a treaty or agreement with the U.S. This provision retains for NASA a royalty-free right to sue an inventor for government purposes, even if patent rights have been waived.

To ensure that contractors will get inventions to use rather than shelving them once a waiver is issued, NASA has established conditions under which certain waivers can be voided. These conditions apply to waivers issued for an invention of predominantly commercial value and those in which contractor investment is considerably larger than NASA's.

In these categories, waivers can be voided if the invention is not developed

to the point of practical application or licensed either royalty-free or at a reasonable rate. These conditions must be met within five years of the grant of a patent or within eight years of the granting of a waiver, whichever is earlier. Waivers can be continued beyond these limits if circumstances justify an extension.

News Digest

General Motors Corp. will build the Missionary ICBM engine exhaust and turbocharger injectors under subcontract from Boeing.

Ralphston Co. has developed a new form of graphite, with controlled crystal orientation, that gives it novel thermal, electrical and other properties and may enable ballistics handle more cores and rocket engines to operate at higher temperatures.

United Aircraft Corp.'s nine month sales and earnings showed a decline in sales from \$91,515,145 from the period a year ago to \$79,454,872, earnings dropped from \$20,594,325 to \$21,151,646. In another report, Grumman Aircraft Engineering Corp. said sales and earnings were \$5,555,644, nearly double the \$2,114,487 for a similar period last year. Sales rose from \$161,135,545 to \$168,528,175.

Republic of Indonesia is purchasing five C-130B transport aircraft from the Georgia Division of Lockheed Aircraft Corp. with an option to buy five more. A substantial down payment already has been made by the Indonesian government, and progress payments will be made under contract conditions. Cost of the C-130B runs between \$2.3 and \$2.5 million depending upon internal equipment and cargo provided. Lockheed reports that the purchase is being made directly with Indonesian funds, with no foreign money involved.

Hiller Aircraft Corp.'s X-58 VTOL is making high speed tests at Edwards AFB, Calif. (AV, June 29, p. 15). Flight testing is scheduled to begin in December. Air Force completed a final engineering visit inspection of the 161-ton 16-wing aircraft last month.

Republic Aircraft Corp. has received threat of the F-105's Pratt & Whitney JT5 engine by 2,000 lb. with the addition of water injection. Total thrust with afterburner now exceeds 26,000 lb.

Electro-hydraulic actuator system to power Missionary ICBM control mechanism will be designed and developed by Chance Vought Aircraft's Electronics Division under contract to Autonetics Division of North American

Airlines Urge Higher Rates for Mail Plan

Lines that would participate in expanded program file objections, reservations to CAB proposal.

By Ford Eastman

Washington—Higher rates than those proposed by the Civil Aeronautics Board for the transportation of first-class mail by air are being urged by a majority of the airlines which would participate in the Post Office Department's expanded program.

Responding to the CAB's show cause order setting forth the proposed rates (AW Oct. 26, p. 38), airline reaction filed at the Board last week varied from outright objection to unqualified acceptance. Several carriers indicated they would accept the proposed rates with reservations, while still others suggested that they be made temporary pending a hearing on their reasonableness.

Meanwhile the Board has scheduled a preliminary conference for 10 a. m. tomorrow requesting each party to present statements of positions as to the acceptability of the rates specified in the show cause order on the following basis:

- **Temporary**, pending conclusion of the proceedings and subject to subsequent adjustment upward or downward from the effective date of the temporary rates.
- **Definite**, final rate basis not subject to retroactive change for a period not exceeding six months from the date of the preliminary conference or the final Board decision in the matter, whichever is earlier.

Rate Formula

In the show cause order, the Board proposed rates based upon the multi-classment rate formula which establishes air mail rates but at 50% discount. This would give domestic trunklines an average return of 89 cents per ton-mile and local service carriers a return of 30 cents per ton-mile, approximately the same as that built now routine under a limited experimental program.

Mail compensation is computed by adding base local charges and the mail ton miles multiplied by the first-class rate of 15.085 cents a ton-mile to terminal charges, which range from 1.66 cents per pound to 16.665 cents per pound, depending upon the size of the originating station.

Major objections to the proposed rates filed by individual airlines included complaints that:

- Terminal charges should not be established at 50% of present charges for air mail and air parcel post because the cost of handling nonpriority mail might be higher than that for air mail due to additional handling problems involved in moving mail as a space-available item.

- Volume of first class mail handled by the airlines will make it more difficult for the carriers to accommodate on a space available basis within the period and the time required by the Post Office Department. In view of the limited time during which first class mail may be held for carriage or else be lost to other carriers, airlines will tend to give priority to this mail. Therefore, some carriers contended that it is not space-available traffic in the true sense and does not justify the 50% discount from air mail.

• CAB has not taken into consideration the amount of air mail traffic that will be diverted because of the expedited movement of first class mail. As the program expands and first class mail service improves, the carriers contend, the public will rely less on air mail.

High Density B-14

Moore-Kearns is modifying a portion of its large fleet of double-deck buses to provide passenger capacity and profit potential.

Both the 18-passenger version of the B-14 and the 24-passenger B-12 are being converted to a 31-seat configuration. Aircraft produced that cost 18-passenger B-12 will be able to gross \$10,000 (with \$3,000-6,000) over annually due to 24-passenger version, while the operating costs will remain essentially unchanged.

The high density B-14B12, now in service on Aerojet's domestic routes, is given additional seat space by reconfiguring the baggage, meals and snack compartment forward of the cabin. Under certain load conditions, a sixth row of accessible seats can be put in the B-14B12's baggage compartment, providing space for four more passengers.

and more on first class mail which eventually could result in a big revenue loss to the airlines.

• Proposed rates, similar as they would apply to the carriage of mail between points in the 48 contiguous states and points in Alaska, are too low and may raise serious questions of cost compensation due to high unit costs of certain operating factors in the service. Rates for non-priority mail moving to Alaska, airlines contend, should be added to the present air mail rates to the state and should not be based upon a modification of the domestic rates which are inapplicable to air mail moving to Alaska.

No objection to the proposed rates were filed by local service carriers, air cargo airlines or the Post Office Department.

Following is the position taken by each carrier answering the Board's show cause order:

• **American Airlines**—Accepted the rates proposed by the CAB provided regulations are amended regarding air cargo from transporting mail out on any basis other than non-priority space-available traffic and prohibiting any air carrier from accepting or storing such mail in excess of that which can be accommodated by the carrier within a reasonable period of time. Higher rates would be required, American said, if the mail were to be given priority over any other class of airline traffic except that moving as deferred air freight, if the airlines were to increase capacity in order to accommodate it. Higher rates would result in a top off loads and if the airlines were to accept or store such mail in excess of quantities that can be promptly accommodated.

• **Allegheny Airlines**—Does not object to the proposed rates and is in agreement with the overall policy decisions expressed in the Board's order. It expressed concern, however, over certain aspects of the proposal, including the volume of mail to be moved and the number of postboxes involved, possible need for a minimum rate per pound handled, and a possible directional imbalance in rates resulting from station distributions. The airline, which asked the Board to maintain a continuing surveillance of the program, also questioned whether the service will, in fact, be on a non-priority basis.

• **Branch Airlines**—Will accept the proposed rates as temporary for the carriage of non-priority mail subject to retroactive adjustments upon the outcome of a Board investigation of the



Boeing Rolls Out First 720 Medium-Range Jet Transport

First Boeing 720 medium-range jet transport is rolled out at Boeing Transport Division factory at Renton, Wash. Assembly the last of 35 to be built for United Air Lines, will be delivered to the carrier in April after Federal Aviation Agency tests are completed. Production 720s incorporate several wing changes from the 707-120, including a new leading edge which increases sweep and delays critical Mach point and throat leading edge flow which improves landing and takeoff performance (AW Nov. 9, p. 48).



plan, Board said, however, it had serious misgivings as to the adequacy of the present rates and suggested adoption of a non-priority mail rate utilizing the terminal charges applicable to air mail but not providing for a percentage of the local charge. Also, it said, opponents to be more reasonable than the 50% allocation of both terminal and local charges from the multi-entrant rate rule. Board also said there would be no reduction in the percentage of existing air mail which would tend to cause existing air mail rates to increase; that the final rates should satisfy fully allocated available tonnage rate based upon all carriers and all operating miles; that the rates for local carriers with Douglas DC-6 equipment and that, while some type of priority status may prove to be desirable as an end result of the Board's investigation, it should not be presented on the basis of the rates set in the Board's current order.

Confidential Air Lines—Objects to the terminal charges which the Board proposes to set at 50% of the present rates in an order which would increase the charges should be the same as those for air mail. The airline also objects to the proposed rates being made final at this time and requests that the Board set a temporary rate instead. The airline sought the establishment of a multi-entrant rate formula and did not object to the proposed local charge of 15.85 cents a mail ton-mile.

Capital Airlines—willing to accept the proposed rates but wishes to understand that the rates to be transported only on a voluntary space available basis. It also reserved the right to challenge the adequacy of the rates if it finds them to be unfair or unreasonable in the future.

Delta Air Lines—While willing to accept proposed rates for carriage of non-priority mail, Delta has serious reservations as to the long-term propriety of the rates for the reason that the charges portions of the formula. It has asked the Board to give full consideration to the average (local) costs of all airline operations involved and to investigate the possibility that its cargo carrier's terminal costs for handling non-

priority mail may actually exceed its terminal costs for handling priority air mail and on parcel post business of such nature as Post Office dispatching procedures, dimensional weight problem and carrier responsibilities connected with its on route inventory, warehousing and return of mail to post office.

Eastern Air Lines—Objects to the proposed rates as being too low but proposed that its local transport charges and carrier responsibilities connected with its on route inventory, warehousing and return of mail to post office.

Northwest Airlines—Objects to the proposed rates on grounds that they are unreasonably low and do not provide adequate compensation for the transportation of mail by air. National suggested the Board to assign the proceeding for hearing. The airline stated that the local rate be set at not less than 22 cents per ton mile instead of the proposed 15.85 cents, and that the local rate per pound be the same as that for freight.

Northwest Airlines—Objects to the proposed terminal rate on grounds that local handling cost will be equal regardless of the type of mail and, therefore, should be the same as for air mail. Northwest also requested that the local rate be increased to exclude Alaska points from the proposed rates and that the rates set for carriage of mail to and from Alaska should bear a ratio to the rates for the present air mail rates which is in line with a modification of the domestic rate.

Pacific Northwest Airlines—Objects to the proposed rates insofar as they apply to the carriage of first class mail between the 48 continental states and Alaska. Cost of air carrier operating in both and within Alaska have been substantially in excess of costs of domestic carriers. Pacific Northwest said, and asked that the rates be based on the cost of operating in both the continental states and Alaska. Cost of air carrier operating in both and within Alaska have been substantially in excess of costs of domestic carriers. Pacific Northwest said, and asked that the rates be based on the cost of operating in both the continental states and Alaska. Cost of air carrier operating in both and within Alaska have been substantially in excess of costs of domestic carriers. Pacific Northwest said, and asked that the rates be based on the cost of operating in both the continental states and Alaska.

state's operations to a relatively limited extent since it does not engage in domestic operations.

Shack Airways—Accepts the proposed rates and requests CAA to establish the rates for its operations.

TWA World Airlines—Objects to the rates on grounds they do not cover the cost of first class mail service and provide a fair profit, no below the rates for standard freight service and are consequently based upon a cost standard without reference to the value of first class mail service. TWA said the rate should be substantially increased to take into account the fact that the mail must either be moved or lost in a relatively short time. It also requested that the rates be increased to 25 cents a ton mile, and that there is considerable justification for a higher rate.

United Air Lines—Does not object to the raising and establishing of the proposed rates. At the same time, United said it does not want its acquiescence in the matter to be interpreted as full acquiescence either in the manner proposed for the computation of such mail charges or in the rates being proposed. The airline pointed out that terminal costs may be somewhat higher than for priority mail and that there is no persuasive justification for decreasing the rate for movement of the mail to be made as in the case of freight.

Western Air Lines—Accepts the proposed rates but reserves the right to challenge its position if the mail is to be carried on any basis other than space available.

Western Air Lines—Accepts the proposed rates, but reserves the right to challenge its position if the mail is to be carried on any basis other than space available.

Western Air Lines—Accepts the proposed rates, but reserves the right to challenge its position if the mail is to be carried on any basis other than space available.

Hawaiian Bids For New Pacific Routes

By L. L. Doty

Honolulu—Hawaiian Airlines, lodged into a request for subsidy by the new competition of Aloha Airlines in the Pacific, is now planning to apply for a subsidy to begin its trans-Pacific flight by expanding its routes in a regional Pacific carrier.

During the recent Trans-Pacific Route Case hearings here (AW Nov. 3, p. 39), Aloha's new President, William L. Allen, presented, disclosed his own concept of the airline as "a regional carrier in the Pacific, serving routes extending out of Hawaii to the major gateways on the mainland U. S., in the Orient and in Australia." The plan is based on the principle that the vast extent of the Pacific will be reduced to regional size by the high speed of the jet transports and constant Honolulu as the hub of the operation where the company's headquarters and maintenance and overhaul base will be located.

The strong support the HAI proposals for the new routes received from local interests within the 50th state, emphasized the opening hearings here (AW Nov. 3, p. 39). The airline, HAI, operates five 747-jets, and has a fleet of 10 DC-8s and two DC-7s. The airline's plan is to operate a weekly service between Honolulu and Los Angeles, San Francisco and San Diego, and to add a weekly service between Honolulu and Sydney.

Allen, who is also president of the airline, said that the airline's plan is to operate a weekly service between Honolulu and Los Angeles, San Francisco and San Diego, and to add a weekly service between Honolulu and Sydney. He also said that the airline's plan is to operate a weekly service between Honolulu and Los Angeles, San Francisco and San Diego, and to add a weekly service between Honolulu and Sydney.

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of Aloha's B-727 with a fleet of seven specially modified 52-seat Convair 440s which are being equipped with an improved exhaust system, triple engine sensors and substantially heavier landing gear. The airline's plan is to operate a weekly service between Honolulu and Los Angeles, San Francisco and San Diego, and to add a weekly service between Honolulu and Sydney.

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with Douglas, HAI will lease the first Douglas DC-8 turboprop transport which came off the manufacturing production line for a period of 34 months beginning Oct. 1, 1962, at a monthly rental fee of \$10,000. The lease price for the plane is \$10,000. The purchase price of the plane is \$10,000. The purchase price of the plane is \$10,000. The purchase price of the plane is \$10,000.

Hawaiian will handle all insurance with All Risk, HAI Insurance and will handle all maintenance and overhaul of the airplane at the Honolulu base.

In the event HAI's route structure is increased as a result of the Trans-Pacific Route Case, the carrier may purchase a maximum of two additional DC-8s from Douglas. If it does, it is requesting a grant, HAI would like an option for three more DC-8s.

Upon evaluation of the agreement, HAI will pay Douglas \$50,000 which will give the carrier the right to lease the DC-8. When the agreement is granted, HAI will pay Douglas \$50,000 which will give the carrier the right to lease the DC-8. When the agreement is granted, HAI will pay Douglas \$50,000 which will give the carrier the right to lease the DC-8.

The airline has not decided whether to buy the Pratt & Whitney JT3D-1 turbofan on the JT3D-3 turbofan but, in any event, it will purchase up to 32 of either model and specify that a fuel boost pump down be provided in the right and all of the necessary gas box at the engine.

Engines will be paid for with quarterly payments with a 7% interest rate on the unpaid balance plus a handling charge of 1% per annum of the purchase price. Current price of the JT3D-1 engine is \$894,690, of the JT3D-3 engine, \$733,790. The manufacturer is offering a seven-year payment period but prefers five years.

Initially, the company will sell rights to the airline as a way of helping to provide the cash required to make progress payments on the two DC-8s and to cover all other expenditures necessary to begin and sustain service. According to a statement by Leon D. Allen, president of HAI, the company is a subsidiary of HAI, Inc. (Hawaiian) should be able to use the necessary funds to operate a trans-Pacific route "assuming satisfactory conditions in financial markets and assuming that nothing has occurred to weaken confidence. The company's present plan is to operate a trans-Pacific route in connection with this hearing." As to the type of operation HAI will

New CAB Member

Washington—Alan S. Boyd has been named a member of the Civil Aeronautics Board by President Eisenhower to fill the remainder of the term of James J. Hector who resigned last September (AW Sept. 21, p. 36). Boyd is a former attorney and chairman of the Pacific Railway and Public Utilities Commission, will serve until Dec. 31, 1962. He will be a representative observer and may have his nomination given to the Senate for confirmation.

Allagheny Orders 540s

Washington—Allagheny Airlines signed an agreement with Nipigon Airways, Inc. to purchase five Convair 440 turboprop transports and took options on 10 more. Aircraft mentioned in the tentative agreement will be Convair 440s converted to Nipigon 440 turboprop power. No decision has been made on which of these bidding companies will be the conversion work. Present agreement between the airline and Nipigon covers purchase of 15 aircraft and maintenance personnel. A definitive contract will be signed within the next few weeks.

Allagheny has been evaluating a leased Convair 440 since July 1 at its Pittsburgh headquarters and Pittsburgh, Allegheny City route is scheduled service.

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unsuitable to sell, Millesimo said.

"It would be our expectation that a substantial part of the equity would be raised through the sale of common stock. It is possible that a portion of the equity could be more advantageously raised through the sale of other equity securities, such as subordinated debentures, possibly carrying conversion privileges, which would ultimately lead to further broadening of the company's common stock base."

Immediately after completion, a credit agreement will be concluded by HAL with its banks. The credit agreement, which will provide for no dividends until the date the DC-8s are due for delivery, will represent the 67% installment due on delivery of the aircraft plus 30% of the cost of spare parts that will have been acquired with equity funds.

Funds to be provided under the credit agreement will not be made available unless the senior debt to equity ratio is no greater than 1.33:1. In addition, recent operating experience must show evidence that the debt can be serviced by the cash flow from operations. If these conditions are not met at the time of delivery of the aircraft, Douglas has agreed to lease the purchased aircraft to Hawaiian for one year to allow the airline time to meet the loan requirements.

Additional payments on the aircraft will be made from excess cash flow from operations as the new routes are developed.

The overall program, therefore, hinges on HAL's ability to win new routes in the Trans-Pacific Route Case. Without the routes, the airline will not purchase jet equipment since its present carrying capacity will not permit it.

During the first 20 years of HAL's 30 years of operation, earnings averaged an 8% return on invested capital without benefit of subsidy. During the past 10 years—since 1949 when Aloha was chartered to operate the inter-island routes—earnings have averaged only 1% after receiving \$12.2 million in subsidy.

Company's reorganization came in 1954 after it had lost \$92,300 because of a default in a short-term bank loan. Following the reorganization, which involved a drastic management shakeup, the carrier worked back into a profitable condition with net earnings of \$185,000 in 1957.

Last year, Hawaiian reported a loss of \$115,000 in the inter-island operation, but net profits from charter operations of its single DC-6C aircraft offset the loss and gave the company a profit for the year of \$58,584. However, because of the success of Aloha's F-27s on the inter-island market, HAL is forecasting a loss for 1970 and is now in the process of filing a petition for

reorganization and now after going off schedule in the spring of 1967.

These problems facing HAL, in its inter-island operation:

- Traffic is sluggish, averaging 135 in. for each passenger at an average ticket sale of \$12.67.

- Operations are peaked by the hour of the day, due to the week and by season. Business day is short with no demand for service before 7:30 a.m. or after 6 p.m. As a consequence, aircraft utilization is low.

- Traffic is unbalanced. High load factors are experienced on flights out-bound from Honolulu early in the morning, but low load factors prevail on inbound flights at the same time. A reverse of this imbalance is experienced by the observer if charted as service.

- Inter-island market is growing slowly. During the past five years, traffic growth has held to an average rate of 5% per year as compared with an annual increase of 11.5% for trucklines and 10% for local airlines carriers.

According to Lown, "There is no indication that our trend will significantly change in the future, even with a substantial surge in tourist traffic among the neighbor islands."

In fact, the major contribution of population and economic activity in Oahu suggests that the growth rate of inter-island traffic may drop still lower unless the trend is reversed by the development of destination areas

on the neighbor islands providing opportunities for local investment and job opportunities.

On the transpacific route, Lown forecasts that in 1962 a total of 174 passengers per week will move in each direction between Hawaii and Japan. He also predicts that an additional 1,875 one-way passengers per week will travel between Los Angeles-San Francisco and Japan in 1962.

Lown made a strong plea for a route to the South Pacific during the hearings. He said:

"Hawaiian Airlines thinks that the decade of the 1960s will witness the opening of the South Pacific to the world and U.S. tourists. Thus far, the very heart of this area has been isolated by the absence of direct air service... Tahiti and French Polynesia represent one of the great undeveloped traffic potentials of the world, and it would be our intention to make a major effort to develop Tahiti, along with other Polynesian islands, to exploit the latent connectivity of interest between that area and Hawaii and between this area and the mainland U.S., in a manner similar to the development of the community of interest between Hawaii and the United States."

Under present plans, HAL, if it wins the route it seeks, will operate 68 flights a week during the first full year of operations.

Lake Central Route Bid Supported

Washington-Lake Central Airlines was recommended last week to replace Trans World Airlines in Cincinnati-Detroit route by an FAA committee.

Suspension of TWA on the route and the grant of a five-year operating authority between the cities by Lake Central was proposed by Examiner Paul N. Pfeiffer on the condition that the local service carrier show evidence that it will be able to serve the route with modern pressurized equipment.

The committee also agreed of the route to Lake Central with nonstop rights between the two cities was to prove the local service carrier, as the Indiana-Ohio area and reduce the carrier's subsidy needs by an estimated \$280,000 annually. Pfeiffer pointed out that the carrier already serves the immediate cities of Columbus and Dayton before the FAA's decision, but indicated it would be willing to sell its rights on the route outright for \$100,000 and to the present one told the Board that the north-south traffic flow between the two cities does not fit together with the airline's primary east-west routing.

In indicating a willingness to relinquish the route, TWA requested that

its final CAB order to the east stipulate that the route was suspended, rather than deleted, from its route system. Chairman, CAB chairman, the committee said that should the five-year award to Lake Central prove unworkable, TWA could then be reinstated without legal complications.

Pfeiffer's report, made by North Central and Piedmont Airlines on grounds that Chicago and Detroit constitute a proper dividing line between the systems of North Central and Lake Central. He said that, while North Central is now better equipped for the new service than its Cincinnati-Detroit equipment, the carrier would still be unable to provide needed out-of-carrier service in the Ohio area.

Pfeiffer, he said, would be in a position to provide Pittsburgh-Buffalo service before the decision, but he said he would offer air nonstop Cincinnati-Detroit schedules as an brief aspect as an alternate schedule.

The examiner added the long stage lengths of some of Piedmont's flights also suggested the airline was concentrating more on the development of long-haul transcontinental traffic rather than commuter services.



These weather items prepared in consultation with the United States Weather Bureau

WORLD WIDE WEATHER STATIONS

(UPPER AIR NETWORK)



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OPERATING in accordance with plans developed by the World Meteorological Organization (WMO) and the International Civil Aviation Organization (ICAO), a vast network of weather stations, generally about 500 miles apart, takes upper air measurements 2 to 4 times daily. Through international cooperation, the results of these measurements are exchanged on a world-wide basis and are made available to the aviation field and the ground public.

Upper air readings are made with balloons carrying radiosondes which re-

port temperature, pressure and humidity at various levels. When available, special equipment also permits measurements of the upper winds at the same time. This combination of information allows meteorologists to analyze the complex structure of jet streams, fronts, tropopause surfaces, etc.

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Four U.S. International Airlines Ask Higher Share of MATS Traffic

New York-Four U.S. international airlines last week submitted a proposed contract to the federal government which in effect would place with them all Military Air Transport Service cargo and passenger business to ports they now serve.

The airlines—Northwest, Sabena and Western, Trans World and Pan American—submitted the proposal to handle all government traffic to the Department of State, Treasury, Defense, Agriculture and Commerce, the Federal Aviation Agency, the United States Information Agency and the International Communication Administration. But a greater share of MATS traffic is a key goal.

President aimed at cargo, the plan calls for lower rates to the government but the exact figure was not specified. This question is under discussion with the tariff and regulatory staffs of the Civil Aeronautics Board. As a corollary, the airlines plan to reduce civil cargo tariffs to the proposed government level.

One effect the proposal would have, if accepted, would be to eliminate supplemental and contract and possibly other carriers from parts of MATS cargo business, and spokesman for the four airlines see possible grounds for objection from Congress.

This situation was spotlighted by a complaint from TWA President Charles S. Thomas at a hearing here recently over the loss by TWA of a MATS transatlantic contract to Overseas National Airways.

Thomas objected to competitive bidding for these contracts which he said was responsible for price cutting to the point where the larger conventional international carriers could not compete.

The suit cited by Thomas was the second last September of a \$219 million MATS contract to Overseas National for four Atlantic and Pacific round trip passenger contracts for which Overseas received funds it apparently to lease two Douglas DC-7s, from General Dynamics and Leasing Division of General Dynamics Corp. to supplement its fleet of four DC-6s. These are same of the DC-7s American Airlines "traded" up for its Constellation 600s on order.

Five other carriers, Alaska Airlines, Capital Airways, Hawaiian Airlines, EAL, Sabena and Western and Slick Airways, also were awarded MATS contracts then, and American International Airways, Inc., a contract carrier, was added later to carry the total contracts to 576 to airlines.

A MATS spokesman and the contracts were awarded according to the

Armed Services Procurement Regulations and in accordance with regulations which prescribe competitive bidding and that certain possible advantages of military business go to small business.

Pan American lost a Pacific contract it had held and one result was the diversion to commercial cargo lines of two of the four Boeing Stratocruisers it had owned for the MATS contract. Their availability may have been a factor in encouraging Pan American to joining in favored Pacific cargo lines (AW Nov. 9, p. 40).

Under the fast-track proposal, all capacity, personnel and facilities used to handle government traffic will be held constantly available by the scheduled airlines on call by the Secretary of Defense in an emergency. On request, 300 additional capacity would be provided specifically by the airlines. This differs from the Civil Aeronautics

System to Reserve Seat in 3 Sec.

New York—American Airlines plans to begin installation in 1963 of a new airside-wide reservation system which will electronically handle individual passenger information as well as flight reservation and maintenance control. With the new system, information stored in a central IBM 5080 computer will be available in seconds to agents in any city on American's route pattern.

Developed for American by IBM after six years of research, the system is expected to go into use during third quarter of 1961. First point probably will be Hartford, Conn., or a city of the same size, to gain experience with the system. The central computer will be located in the New York area. By summer of 1962, most major cities will be joined to the system, with New York and Chicago linked in early 1963.

In a typical reservation transaction

Northwest Electra Order

Minneapolis—Northwest Airlines to spend eight long-range Lockheed Electra last week at a cost of \$12.6 million, beating the carrier's Electra fleet up to a total of 15. The additional eight Electras are being ordered to increase fleet capacity to 1,660 gals and possible those with a 3,000 gal. range. Schedule calls for delivery of two Electras in May, two in June and four in July. Northwest expects to have the transports operating over the majority of its routes by early summer.

Reserve fleet availability, which requires a declaration of a national emergency. A spokesman for one of the airlines said that the carrier planned to accommodate possible variations in government requirements for capacity by an increase in commercial cargo business expected increase of the related rates. These reductions would be possible because the airlines' government business would provide.

The airlines say that not only would the proposal permit them to acquire fleets of turbine-powered cargo aircraft but would also prevent the retirement of older aircraft by airlines who will be displaced afterwards by the arrival of more efficient jet transports.

The proposed agreement would remain in effect indefinitely unless terminated on two years notice. It would have to be approved by Civil Aeronautics Board as is the public interest, and could be terminated at any time by CAB if it found the agreement no longer in the public interest.

Submission of the plan was in accordance with a request by CAB order, the airlines and (AW Aug. 24, p. 13).

the airline agent selects and inserts in an console an air information card which lists flight, frequency, departure times and the like over the desired route. The agent, who may be located at any city in the system, then queries the central computer by push-button and receives availability information.

With a flight selected, the agent presses a "call" button and the computer displays its inventory and prints a record of the sale on the agent's printer, in words. Before reservation can be handled in the same way. Then the agent types each information in passenger's name and telephone number as the printer and the computer stores and acknowledges this information. Then, if the computer checks the record for correctness and advises the agent of correctness or any cost.

If a passenger's name is misspelled and the computer alerted for his record, the computer will find the most likely name and present that record, with a note that the spelling is inconsistent.

By handling the passenger record as changing name and phone number, the computer also is able to handle fee for use of private carrier as of the transportation discounts of current reservation systems. Over all, American says the system will cut the average reservation transaction time from 15 min. to three seconds.

Agents for the system are still under way by IBM, but the computer is already coming off the company's production line for other business sites.

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Airline Traffic—September, 1959

| | Passengers | Revenue Passenger Miles (RPM) | Load Factor % | U. S. Mail | Express | Freight | Ticket Revenue Ten-Miles | % Revenue to Available Ten-Miles |
|-------------------------|------------|-------------------------------|---------------|------------|-----------|------------|--------------------------|----------------------------------|
| DOMESTIC TRAFFIC | | | | | | | | |
| American | 750,143 | 343,777 | 73.7 | 1,813,128 | 1,025,124 | 9,615,346 | 66,051,728 | 64.3 |
| Boeing | 179,911 | 79,544 | 59.5 | 325,363 | 179,191 | 8,808,137 | 8,808,137 | 86.3 |
| Capital | 343,399 | 129,038 | 61.7 | 804,807 | 319,471 | 442,844 | 14,419,418 | 45.3 |
| Continental | 107,260 | 71,284 | 33.9 | 131,323 | 101,303 | 319,150 | 7,333,277 | 41.9 |
| Delta | 344,194 | 130,086 | 60.7 | 413,889 | 348,453 | 1,951,432 | 11,790,464 | 51.9 |
| Eastern | 757,044 | 310,474 | 60.24 | 1,009,193 | 347,439 | 1,367,343 | 34,139,462 | 36.8 |
| National | 126,145 | 72,918 | 48.5 | 137,946 | 95,374 | 544,374 | 7,128,521 | 41.4 |
| Northeast | 114,784 | 58,343 | 50.7 | 79,413 | 47,472 | 172,407 | 2,654,135 | 27.3 |
| Northwest | 144,749 | 127,143 | 61.0 | 344,767 | 302,348 | 1,642,321 | 14,234,279 | 33.3 |
| Trans World | 473,148 | 174,164 | 79.1 | 1,419,348 | 718,330 | 4,028,118 | 12,688,118 | 49.6 |
| United | 628,420 | 431,444 | 73.4 | 2,345,210 | 1,314,443 | 8,216,916 | 31,684,413 | 42.0 |
| Western | 129,495 | 68,434 | 41.1 | 307,006 | 94,343 | 301,441 | 8,724,055 | 59.4 |
| INTERNATIONAL | | | | | | | | |
| American | 5,384 | 9,140 | 46.9 | 9,043 | 479 | 100,144 | 1,143,038 | 32.3 |
| Boeing | 4,245 | 6,153 | 34.3 | 32,399 | — | 86,411 | 1,283,243 | 56.3 |
| Capital | 30,440 | 1,520 | 1.447 | — | — | 4,499 | 798,385 | 73.8 |
| Delta | 4,507 | 5,323 | 34.3 | 6,440 | — | 31,302 | 433,433 | 47.3 |
| Eastern | 39,337 | 62,447 | 57.38 | 44,548 | — | 135,864 | 4,407,739 | 54.48 |
| National | 7,821 | 1,240 | 43.4 | — | — | 4,083 | 173,580 | 42.4 |
| Northwest | 8,241 | 4,304 | 49.4 | 9,334 | 5,413 | 31,261 | 324,337 | 46.9 |
| Trans World | 17,448 | 32,444 | 57.5 | 1,300,477 | 37,347 | 97,374 | 8,636,444 | 58.3 |
| Pan American | — | — | — | — | — | — | — | — |
| Alaska | 4,913 | 5,699 | 59.6 | 64,428 | — | 171,148 | 754,267 | 59.6 |
| Alitalia | 120,113 | 191,443 | 57.4 | 1,244,158 | — | 3,385,921 | 24,197,191 | 49.4 |
| Latin America | 100,491 | 192,741 | 60.8 | 399,491 | — | 4,449,363 | 16,736,704 | 49.8 |
| Pacific | 30,358 | 133,130 | 60.1 | 1,841,804 | — | 3,141,149 | 14,407,434 | 73.7 |
| Passenger | 18,341 | 27,358 | 46.413 | — | — | 484,431 | 4,044,281 | 48.9 |
| Japan | 22 | 44 | 18.1 | — | — | 5,773,355 | 3,714,764 | 64.3 |
| Trans California | 7,413 | 12,317 | 62.8 | — | — | 397,123 | 5,344,241 | 71.1 |
| Trans World | 47,379 | 100,115 | 51.1 | 814,504 | — | 2,144,505 | 16,102,197 | 49.8 |
| United | 19,782 | 24,412 | 74.6 | 138,346 | — | 93,362 | 2,451,391 | 71.1 |
| Western | 5,023 | 7,411 | 59.3 | 9,491 | — | 13,557 | 844,193 | 73.3 |
| LOCAL SERVICE | | | | | | | | |
| Allegiance | 24,483 | 9,970 | 46.4 | 11,935 | 34,125 | 34,341 | 149,473 | 47.3 |
| Allegiance | 18,794 | 4,930 | 40.3 | 5,713 | — | 8,497 | 467,407 | 44.3 |
| Central | 13,478 | 3,679 | 39.2 | 4,719 | 3,739 | 14,748 | 381,479 | 46.0 |
| Frontier | 38,329 | 8,319 | 38.0 | 32,392 | 1,370 | 79,401 | 418,467 | 41.6 |
| North Central | 31,141 | 5,319 | 40.8 | 1,330 | 21,361 | 21,361 | 387,410 | 4.6 |
| Northwest | 48,443 | 9,813 | 40.4 | 11,367 | 19,999 | 18,933 | 95,714 | 44.3 |
| Omaha | 44,354 | 10,458 | 46.48 | 34,368 | 36,180 | 24,368 | 1,472,184 | 49.18 |
| Omaha | 69,717 | 9,617 | 44.9 | 14,435 | 21,417 | 18,938 | 118,708 | 49.7 |
| Pacific | 42,423 | 16,433 | 38.3 | 16,433 | 4,413 | 7,421 | 944,112 | 24.6 |
| Providence | 5,137 | 5,714 | 46.3 | 11,354 | 14,424 | 39,447 | 418,354 | 41.6 |
| Southwest | 71,680 | 3,319 | 37.5 | 5,444 | 5,700 | 17,133 | 379,514 | 39.8 |
| Trans World | 35,527 | 4,346 | 39.6 | 19,441 | 10,100 | 44,449 | 662,491 | 38.6 |
| West Coast | 22,343 | 7,413 | 46.23 | 9,449 | 3,367 | 18,441 | 716,438 | 43.4 |
| HAWAIIAN | | | | | | | | |
| Alaka | 34,000 | 3,333 | — | 3,000 | — | 3,315 | 330,377 | 23.8 |
| Horizon | 34,000 | 5,349 | 59.3 | 9,316 | — | 149,718 | 678,797 | 58.8 |
| CARGO LINES | | | | | | | | |
| AARCO | | | | | | | | |
| American Fed American | — | — | — | — | — | 4,679,438 | 4,270,438 | 70.72 |
| Flying Tiger | 1,612 | 8,100 | 100.0 | 43,373 | 102,716 | 448,457 | 305,807 | 64.8 |
| United | — | — | — | — | — | 13,387,323 | 10,387,438 | 53.3 |
| Western | — | — | — | — | — | 4,144 | 1,427,710 | 73.2 |
| Western | — | — | — | — | — | 4,647 | 518,519 | 77.7 |
| Yorkland & Western | 288 | 1,173 | 180.80 | 397,324 | — | 2,416,444 | 3,739,761 | 40.27 |
| York | 8,133 | 19,794 | 99.37 | — | — | 3,747,410 | 2,748,247 | 74.85 |
| MICROPOST LINES | | | | | | | | |
| Alaska Airlines | 22,254 | 474 | 40.7 | 1,305 | — | — | 40,407 | 66.3 |
| Alaska | 4,144 | 143.8 | 20.3 | 4,413 | 3,447 | — | 56,468 | 81.8 |
| New York Airways | 11,444 | 319 | 64.9 | 1,133 | 734 | 433 | 21,340 | 33.8 |
| ALASKA LINES | | | | | | | | |
| Alaska Airlines | 10,390 | 8,400 | 59.7 | 54,710 | 6,397 | 365,340 | 1,303,327 | 81.8 |
| Alaska Coast | 4,508 | 4,508 | — | — | — | 5,415 | 67,132 | 82.4 |
| Coastline | 1,432 | 343 | 23.8 | 8,313 | — | 46,378 | 16,449 | 81.8 |
| Sea | — | — | — | — | — | — | — | — |
| Seattle | 2,303 | 926 | 48.4 | 38,481 | — | 63,463 | 1,168,133 | 63.4 |
| Pacific Northwest | 11,331 | 10,361 | 40.7 | 104,719 | 7,474 | 334,910 | 1,433,133 | 81.8 |
| Trans Alaska | 1,304 | 1,324 | 39.1 | 46,156 | — | 91,479 | 207,436 | 82.8 |
| West Alaska | 3,219 | 1,131 | 28.3 | 39,134 | — | 174,704 | 301,436 | 50.2 |

*Not available.
Compiled by AIRLIFT WEEK from station reports to the Civil Aeronautics Board

Medics Stress Seniority Rule Problems

By Russell Hawkes

Santa Monica, Calif.—Medical problems of trauma in jet aircraft were somewhat antedated by the Air Line Pilots Assn. strike last winter and seniority rules which sent older crews into transition with little time remaining before the start of service. American Airlines Medical Director Dr. K. L. Stratton told the University of the City of Los Angeles aviation medicine symposium here.

Upset stomachs and other signs of tension under the pressure to complete training in minimum time have been attributed at least partly to the age of the first crews assigned to jets. Younger crew learn more rapidly, Stratton believes, and they would have shown less evidence of stress under the circumstances.

The pilots' strike reduced the time available for transition training before initiation of jet service.

Equal Learning

Dr. Stratton said there is no reliable evidence that older pilots commit far jet traumas as well as younger ones, but their transition period should be stretched to obtain equal learning without increased stress. At first, some crews were completing transition training hardly in time to fly new airplanes flown from the factories. In this hurried time situation, there were some upset stomach cases and other evidences of tension.

Those rapidly disappeared as better

turning became possible. Understanding of emergency procedure aircraft techniques seemed easy enough for all pilots, regardless of age or experience. After 10 months of experience with the Boeing 707, Dr. Stratton reported no medical deterioration of pilots and flight engineers due to stress of flying the jet.

However, the workload appears to be great enough to justify the four-man crew used by American. Eye strain is reduced by better window tint and more effective red lighting of cockpit at night. Cockpit loudspeakers eliminate the annoyance of having to wear a headset continuously. Pilots still get the benefits on for any necessary communication but monitor the loudspeaker until they hear their call sign or make a transmission.

Regarding complaints of unusual susceptibility to stressors on jet service, Dr. Stratton said there is not enough experience accumulated to tell whether the percentages of disturbances are significantly higher than for any group of women in the 20-30 age bracket. If it was, it is nevertheless common, that is, as stressors common to crew for and less time on jet rate, but there are also four stressors rather than two.

Dr. Ludwig G. Loderer of Capital Airlines commented that this is a cyclic problem for airlines which occur whenever new equipment being placed in is very different from the old equipment.

He cited the transition to gas-

turbine aircraft and Capital's transition to the turboprop Viscount. In the past the problem has disappeared after a few months. Dr. Stratton recalled an instance in which replacement of incandescent lighting by fluorescent lighting in a large office caused a transition problem in companies of new-graduated engineers by desks and typists. In a later rearrangement of the office, incandescent lights were temporarily installed and the number of complaints rose again.

Pilot Age

United Air Lines Medical Director, Dr. George J. Kidera, defended older pilot adjustment age criteria, though acknowledging there is no contrast correlation between chronologic and physiologic age. He pointed out that the probability of sudden incapacitation increases with age. In many cases it is unpredictable or unpredictable.

Studies by United pilot physical examination reports as far back as 1917 show that examination found no basis for the prediction of disease or defects in later life.

In the case of psychological incapacitation, a study of color personality tests and psychiatric interviews showed no clue to the approaching collapse.

Chief Raps Aerofoil Training Practices

Moscow—Crackdowns on Aerofoil practices ranging from pilot training to passenger service is being spearheaded by the chief of the state-owned airline, Col. Gen. Avdon Voznesensky Logvinov.

The Aerofoil chief also has charged airport operations with being "scandalously negligent" in providing services for travelers (AVN No. 3, p. 5). In an article published in the magazine *Col. Avdon*, Logvinov called for more pilot re-training, improved preflight, and "sharper" Logvinov, who replaced Mikhail Pavlov Zhigalov as the Aerofoil chief, and because of Aerofoil's last expression "we can no longer afford 31% more than the year before." He told airline personnel from baggage carriers to aircraft manufacturers to turn in more published and competent performance.

Pointing out that winter navigation was beginning in Russia, he cited examples of pilots who landed the wrong airport, making a single mistake and weather landing. Logvinov said these pilots explained they only got one training day every two months. "So it turns out pilots make mistakes in the air not

because they don't know or don't like flying but because they have that dull, insufficient quantity to land without landings." Logvinov added "It is the fault of division leaders who first care it is time to understand pilot qualifications should be looked at not only for written examinations but also for training the number of bad weather landings and traps made under instrument flying conditions."

Preflight preparation, he said, sometimes is inadequate. He mentioned a pilot as the Ukraine who crashed after taking off in an overloaded crop sprayer aircraft. "It is our sacred duty to carry passengers according to the timetable," Logvinov stressed. Referring to passenger service, he demanded that baggage handling facilities be improved and "loading baggage to the wing and dress coat stop." If baggage is lost, it must be treated like a special accident and blame must be strictly apportioned.

Passengers have complained that they cannot get exact information about information business and "this must be improved."

Turning to ground equipment, he said fuel tanks must be inspected and color and aircraft tags checked. To eliminate crowding at airports, Logvinov said terminals must be constructed. He pointed out it being done now in Moscow, Leningrad and Kiev.

With winter coming, the Aerofoil chief and hotels and airports must prepare for grounded passengers, especially on the Siberian routes. Touching on Aerofoil expansion, Logvinov made these points:

- Nearly 50% of Aerofoil traffic in August was carried on jets and turbo-prop.
- During the first eight months of this year, Aerofoil carried 45.5% more domestic traffic than in the previous year.

British to Support Eurocontrol Studies

London—Britain has pledged support for European efforts to study control as integrated as traffic control system covering upper airspace in northwestern Europe.

New Minister of Aviation, Duncan Sandys, informed a meeting of common secretaries-general of civil aviation in Brussels that Britain would join as a study of legal, technical and other problems involved.

Common market countries have been working on a project for an integrated flying control system known as Eurocontrol, in parallel with a development system to reduce collision risk between civil and military aircraft at high altitude.

COCKPIT VIEWPOINT

By Capt. R. C. Robson



The Spoken Word—Part IV

Terminal control today is almost exclusively a function of voice communications. In the final analysis, it is the airport and its attendant approach facilities which determine the capacity of the air. It is no secret that airport delays continue to get worse. The average landing rate over a given interval of time is sometimes used to prove that airports are inefficient operating at a high capacity, but with proper voice communications we could do much better—we could achieve a higher "constant velocity" with greater safety.

IFR-VFR Priorities

Another area in which work is needed concerns the relative priority between IFR (Instrument Flight Rules) and VFR (Visual Flight Rules) traffic. For instance, should the aircraft which filed a flight plan and followed an arrival clearance (IFR) be delayed for landing VFR traffic? Or should the VFR flight be held for the IFR aircraft on instruments?

This one particular item has already reached the point of open warfare when the two types of traffic conflict in the terminal area. Long hangars and long runways are continuously heard with both parties claiming priority in handling as they attempt to argue it out on the air. This further causes the frequency, a factor which further reduces the flow of traffic.

Airport Dilemmas?

During periods of low weather such conflicts do not occur—everyone is IFR. But pilots are beginning to wonder why, when it is not absolutely necessary, should they go through the rigors of filing a flight plan and adhering to a clearance in order to be held for the landing of a pilot who took off, flew and arrived completely unassisted? Of course the VFR pilot has exactly the same query. If this particular problem is not solved, our entire traffic problem is going to be resolved by dilemmas around the airport.

A criticism of this occurs when an aircraft completes an entire IFR flight, including an instrument approach, then finds it must avoid the airport to land behind VFR aircraft. Does this constitute unilateral cancellation of the pilot's ATC clearance without his consent? And does it have the same required aspects of a legal clearance—such as time to do in case of radio failure, etc?

Tower Operating Policies

Some of these problems are partially solved by the operating policies of particular towers and it should be noted that those probably are no perfect answers. At McClellan Field, for instance, arriving aircraft must make their last radio contact with Tower Approach Control. In this event, 10 to 20 minutes, depending upon magnitude of weather conditions, aircraft are held, cleared, descended, cleared or speeded as necessary to arrive at a point and suitable landing time—again another as this is possible.

At Washington National no such action exists. Except in totally IFR weather, Approach Control contact is not rigidly required, the approach controller can be interfered with the flight of the aircraft, makes no attempt to coordinate, give practically no traffic information and rarely volunteer weather information. Finger pointing at this point could reduce the work load on tower frequencies and result in greater airport capacity.

Several Cockpit Viewpoint columns back, the contention was made that voice communications should continue to be our mainstay in the control of traffic for many years to come. Let us hope for action soon on the spoken word.



Sabena 707 Intercontinental Makes First Flight

Sabena Belgium World Airlines' first Boeing 707-120 (AWN Oct. 26, p. 47) makes its maiden flight at Weston, Wyo. After a 2 1/2 hour landing was made at Weston Field, Seattle, where the aircraft will be based for final tests. Sabena's first 707-120s will have 134-seat capacity.

A space research
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One of the largest manufacturers of motor power units in the world, Bristol Siddeley Engines Limited produce the Gannet.

A liquid propellant rocket engine, the Gannet powers the Saunders Roe Black Knight, Britain's highly successful space-research vehicle. An extremely reliable powerplant, the Gannet produces a total sea-level thrust of 16,400 lb (7,438 kg) and nearly 19,000 lb (8,618 kg) outside the earth's atmosphere, for a total powerplant weight of only 700 lb. The Gannet sends Black Knight over 500 miles into space above the Woomera rocket range in Australia.

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AND THIS



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AND THIS



The Bristol Siddeley Proteus powers the Rotaxan engine. Four Proteus give the 130 seat transport a speed of over 400 mph—a range of over 5,000 miles. Bristol also are in service with turbine engines and with RAF Transport Command.

AIRLINE OBSERVER

► Watch for an order for additional Boeing 707-320 intermediate-range jet transports for Australia's Qantas Empire Airways. Present in the company to buy de Havilland Comet 4s apparently has been resisted successfully.

► British government will increase borrowing power of British Overseas Airways from \$440 million to \$504 million and British European Airways from \$164 million to \$260 million for a total increase of \$134 million.

► U.S. airlines were flying more jet planes and jet passenger miles in 1958 than they did any other month, according to a survey conducted by the Civil Aeronautics Board. During 1958, the survey reported that four U.S. airlines flew 5.1 million jet miles, or 43% of the week's total. However, according to the Board, the single Soviet airline, Aeroflot, accounted for 33% of the world jet transport mileage. Most extensive network of jet routes was operated by the United Kingdom—32,754 mi. U.S. carriers operated 26,855 mi., Aeroflot 21,096 mi., Aerolineas Argentinas, only Latin American jet operator at the time of the survey, had 16,040 mi. of jet routes.

► Lufthansa German Airlines proposal to eliminate foreign carriers' cabotage rights within the West German Federal Republic will be turned down by the German government. At present, foreign carriers—including Pan American, British European Airways and Air France—have rights to cabotage coastal flights do not start within two hours in either direction of a Lufthansa flight on the same internal route. Lufthansa, in asking for a restriction of these rights, claims that cabotage amounts to discrimination and has resulted in a heavy loss of revenue. Recently, the airline reported a 1958 deficit of \$7.64 million, largest in the company's history.

► KLM is only planning few and small-hourly short-haul aircraft utilization for its Tu-114 turboprop transports during this initial period of scheduled service. However, Soviet commentators say Tu-114s flying 2,000 hr. annually with passengers now handled by long-distance traffic "will save enough" fuel each year to equal the salaries of at least 10,000 men to the nation's work force.

► Trans World Airlines has filed a complaint with the Civil Aeronautics Board charging Allegheny Airlines with unfair and deceptive practices by allowing transmissible use of one-to-one tickets between Pittsburgh and Philadelphia. In its complaint, TWA claims that, although the consumer tickets are not transmissible under the terms of the tariff, Allegheny is conducting a campaign in which prospective purchasers are advised that "consumers are transmissible." TWA earlier charged that the Allegheny plan is discriminatory (AW Oct. 19, p. 47).

► Northwest Orient Airlines has installed an cabin on one of its Boeing 377 trimotors which operates over the New York-Chicago-Minneapolis route on a trail basis to get passenger reaction to organ case placed in front. The organ, which weighs 180 lb., has been modified to fit into the plane's seat tracks. Carrier is now lining up organs to run the musical instrument.

► Swissair will offer a 1-cabin service to first-class passengers on transatlantic flights. Passengers will sit out front 48 hr. in advance of departure time to select their dinner from menus which will include up to 10 main courses, and five desserts.

► Argentine government has refused to allow Pan American World Airways to operate more than one weekly jet flight between New York and Buenos Aires. As a result, Pan American has been terminating its weekly jet flight at Acapulco but, because of the relatively light traffic in and from that city, the airline requested an exemption from the Civil Aeronautics Board permitting an extension of the service into Montevideo to help compensate for the loss of revenues caused by the Argentine embargo. Last week, the CAB granted the airline a one-year exemption authorizing the Montevideo service.

SHORTLINES

► British European Airways is scheduled to take delivery of two Comet 4B jet transports from de Havilland Aircraft Co. six months ahead of two months ahead of schedule. BEA has seven Comet 4Bs on order with de Havilland and is scheduling operations for Apr. 1, 1959.

► Chicago Helicopter Airways reports it carried 105,132 passengers during the last 10 months of this year, a 79% increase over the same period of last year. Passengers carried during October rose 91.1% over October, 1958, to 12,265.

► Flying Tiger Line realized third quarter net earnings of \$443,690, a decline from the \$596,150 net earnings during the same period of last year. The all-cargo carrier showed reductions in U.S. government contracts as a reason for the decrease.

► KLM Royal Dutch Airlines third quarter operating revenues totaled \$44.3 million, a 12% gain over the corresponding period of last year. The carrier reported net earnings for the period of \$4 million, a 16% increase over the third quarter of 1958. Nine months' total operating revenues were \$307.8 million while net earnings for the same period were \$14.4 million, 5.6 and 2.8% increases respectively.

► Los Angeles International Airport has been estimated to be increased by \$18,000 in more a year as a result of voluntary adjustment of landing fee contracts with its major airlines. The new rate is 10 cents per 1,000 lb., a move that 100% increase over the old rate of 4.6 cents. Affected airlines are American Airlines, Pan American World Airways, Trans World Airlines, United Air Lines and Western Air Lines.

► Mohawk Airlines has purchased a fifth Comet 4B-400 from Convair Division of General Dynamics Corp. for approximately \$700,000.

► Pan American World Airways reports it has flown more than 210,000 passengers on its fleet of Boeing 707 turboprop aircraft during the first year of operation ended Oct. 26.

► Vickers-Armstrongs has sold a Viscount V. 745 series turboprop transport to Philippine Airlines. The sale, including the Viscount V. 754, had the airline total orders to three and Viscount sales to 408. The new Viscount will be operated on PAL's Hong Kong and domestic de luxe schedules.



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LANDING PLATFORM was built in rugged mountainous country near Denison Creek, B. C., to service a mining company operation. The helicopter operates after have blasted landing areas out of rock ledges during the freight passenger loads into the mountain.



BELL helicopter makes a landing on a temporary log platform in mountainous country; this is a typical landing site for mountain work. The company today operates up to 54 helicopters on a variety of missions, ranging from hauling of freight to power and pipeline patrol.

Okanagan Copes With Helicopter Mountain Flights

By Richard Sweeney

Vancouver, B. C.—Persons in development of the approach, landing and take-off techniques which make mountain operations feasible with helicopters, Okanagan Group here has given to the long-run, rugged aerial transport service firm in the world.

Okanagan's growth in 12 years to where it can keep here a fleet of 37 helicopters—one Sikorsky S-55, six S-60s, five Bell 47s, four Bell 47G-1s and 24 Bell 47G-2s—is based on a company philosophy that those who fly and maintain the machines are important. Customers use these machines doing the job fast and efficiently. Results: the helicopter crew are in the best position to sell Okanagan's services on a repeat basis to existing customers and build up good will to attract potential customers.

In addition to the 37 aircraft now owned, Okanagan has bought two new Sikorsky S-55s, which were to be delivered during October. The company also operates 84 Royal Canadian Air Force Sikorsky S-55s, under a contract

to supply the Mid-Canada Radar Detection Line. All told, the company operated 54 machines that put revenue.

Current operations consist of conventional helicopter work, freight and personnel hauling, plus patrol of pipelines, powerlines, etc. However, two future prospects are under consideration by Okanagan as the passenger field.

Omega Order

The company has ordered three Omega BB-11D two-engine, single rotor helicopters with about 1,000 lb payload over a 100 mi range, carrying three to four people plus pilot (AW July 27, p. 41), and with these in its Bell machines may start a service known as "Capitol Copter." In this, Okanagan is seeking to sell various business firms blocks of time with the helicopter, to be used for executive transport or high priority material movement.

Under this system, which has been used in the U. S. in several instances with fixed wing operations as well as rotary wing, the leasing firm buys a certain amount of flight time in a given period, perhaps per month or three



BELL B-1 helicopter is shown on a rough landing platform at Pelly Lake during Okanagan's early days. Company since has expanded to several groups.



PREPARING a black and white rig, Okanagan crew prepares to make an engine change during the early days of Okanagan's trips into the back country of Canada.

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months or six months, to be used here over the company's main. Carrying enough chairs would enable Oleson to keep one at more runways occupied in that enterprise all year around.

The Oleson purchase is not tied to the passenger deal, there are plans for using these machines in the bush.

Second passenger idea has its roots in a firm order for one F4U Rotundine VTOL, plus options on two more. This machine, for delivery in about 1953, should go about 45,000 lb., be able to carry 70 persons at a good speed and operate in all weather conditions from city center to city center. Intended route is the Vancouver, Victoria and Seattle triangle, to which this aircraft seems well suited. Oleson feels the plane would cost about \$3.6 million and would be able to make the 65 mi run for a fare of about \$30 per passenger, at a cost approximately 44 cents per passenger mile. Passengers would be Kala-Kiver-Tyne tribesmen.

Powerline Work

Although the company's activity usually is confined to Canada and parts north, last summer the S-51 was used by Southern California Edison Co., in installing 15 powerline transmission towers near Palmdale, Calif. This came about when Southern California Edison, which possesses powerline easement over helicopters (AW Nov. 4, 1951 p. 12), had throughout the U.S. to serve as S-51 for work but could not find suitable. Oleson was contacted and did the job with Federal Aviation Agency permission to operate in the U.S. and also performed the work in Canada on the elevated cost.

Oleson started in 1947 when former RCAF pilot Carl Agre convinced local growers of the Okanagan Valley, northwest of Vancouver, that a helicopter would be excellent for spray-down operations on their fruit trees. With Agre, the company (technically) half of the team, was All Steiger.

Groves subscribed enough funds to buy a Bell B-5 open cockpit machine, with Douglas Dewar as the highest single subscriber. After the machine was bought and tried out, it was found that due to terrain and the small blocks of various kinds of trees, the rotary winged aircraft was just not the right one for this work in this area.

In 1948, the operation was moved from Okanagan Valley down to Vancouver, and the helicopter was used to spray mosquito-infested waters following a flood and also to spray a large Christmas tree grove.

After this, the Typograph Division at the Department of Lands and Forests of the B.C. Provincial Government approached Oleson to use if the helicopter could be used in its survey work in the mountains.

It was at this point that Agre began to develop the mountain flying techniques which have made both him and Oleson famous. It was requested for the survey that Agre land at a site which was 5,300 ft. above sea level. The spot chosen was a small lake, about 1.65 ft. across, covered with snow and ice. The small lake was situated on the side of a mountain, in a pocket. The lake did not completely fill the rocky cuttings, leaving a lip which projected about five to 10 ft. above the surface of the water. The side of the mountain from which this small lake and it pocket projected had a slope of from 45 to 60 deg.

Although it was during August, the snow and ice were plainly visible. However, the question was the site, that is, whether it could hold the helicopter or not, was the big question.

Up to this time, conventional helicopter technique called for assuming a predetermined rate of descent along with a rate of forward travel which resulted in a relatively steep approach to landing. However, for this situation, Agre felt that a flat approach to the lake would be best. In addition, there was the problem of engine power available at this altitude.

Agre started making approaches toward the lake along a relatively flat path. This way, he would start a distance out from the lake and slightly above it, approach the lake with a fairly slow forward speed, and then come into it at a steep angle. This gave him the opportunity, should the need arise, to back away from the lake and be headed downhill, in order to gain flying speed. In essence, this became a "down-and-come" engine route.

Swaks Flies

Altogether, Agre made seven fly-bys at the lake before making his first landing attempt. He used made three or four approaches toward the lake. His approach flight path slope into was approximately 7 to 1. On the next to last approach he slowed the helicopter to 5 mph forward speed, and figured that on the next pass he would reduce forward speed to zero and touch down gently.

Flying the helicopter in along the flat topography, at a very slow forward speed, Agre allowed the nose to rise as the rotor came into the snow covered lake surface, lowering the collective pitch a little at a time.

When the helicopter had settled completely, he left the engine running fast, twisted a cyclic to two, and then took off again. In the run of the pocket which held the lake, there was a V-notch. The helicopter's nose had been pointed toward the notch and as he flew the machine out the rotor blades were just slightly above the rim



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of the wall, while the helicopter fuselage passed through the notch itself.

This was the aim of the invention. Swing techniques which have been copied by military and civilian helicopter operators throughout the world. It is the flat approach trajectory, in combination with a very slow forward speed.

Other parts of the approach technique include reducing the forward speed to two to three miles per hour as the helicopter approaches the landing pad and attitude is reduced to approximately one foot above the surface. A very slow or zero forward speed is established and then the helicopter is allowed to settle onto the pad, in a nose-high attitude noncommittal of a foot wing upstroke landing. This requires development of technique to prevent bending and breaking tail rotor.

When training new pilots, Okanagan instructors do not use specific exact approach angle. Rather, each pilot is allowed to select the one he feels most comfortable with, and then handle best which fits within the acceptable limits.

Second big task in mountain flying with helicopters is finding the wind, and, having found it, knowing to cope with it. The wind and the approach, are two major techniques which are taught new pilots in Okanagan's training program. In addition, these facts are stressed in Okanagan's training courses for others, such as the U.S. Army, French air force, and various civilian government agencies.

Side Approach

In addition, the method has resulted in one of a side approach as a rule, that is, the helicopter approaches angled sideways to the wind. This is the same what intends. This is, the pilot is always ready to turn down and away as one of emergency. Among items on the helicopter list of helicopter notes, flying in climbing up slope into a wind. Also, the technique calls for making very wide, flat turns, rather than steep, short radius turns.

The rule of descent onto the pad is important in the Okanagan mountain technique. The actual rate of descent is somewhat secondary and the side forward speed is one of the most important phases. Approach of final approach and landing technique experience, it has been found, according to Okanagan, that rate out of 10 seconds in helicopters in general occur under 10 mph, and of this, the biggest percentage occur under 5 mph. In addition, there are even more that happen either on the ground or in a low hover.

After Agar had satisfied himself over a period of time, as to the efficiency and safety of the flight technique he had evolved for landing on the sides and tops of mountains, in October,

THE GRAND CENTRAL REPORT

Solid propellant rockets are a nuclear art, but only a working new technology permits us to build the huge, high performance solid propellant rockets that propel today's missiles and research vehicles. Large solid propellant rockets will dominate military rocketry of the future. Solid propellant rockets also play a major part in scientific space exploration. The Grand Central solid propellant rockets are today's most reliable new rocket.

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were used to develop special shock/noise mounting system for equipment on *Avrocar*. Surface-to-air environment of this Mach 2.5 missile requires superior performance, excellent damping and high natural frequency (above 60 cps). Lightweight suspension isolates equipment from extreme disturbances including shock, high-frequency vibration, random excitation and sustained accelerations to 10G.

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are introducing extremely sophisticated requirements for shock and vibration protection. Unusual equipment placed on *Atlas*, *Titan*, *Minuteman*, *Sentinel* and *Boomer*. Lord is now developing high performance mounting systems for such advanced projects as *Minuteman* and *Mirvay*. Selection of Lord to custom design, test and manufacture mounting systems for these projects reflects Lord's outstanding capabilities for reliability protection.

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staves, heaters and other material. Following the work on the Alcan project and its attendant expenses for Okanagan between 1941 and 1951, the next operation which marked a milestone for the company began in 1956 when the first record is credited as the Mid-Canada Radar Defense Line. At this time, the Royal Canadian Air Force gave Okanagan 14 Sikorsky S-55 helicopters to operate. These are still working to maintain and supply parts of the line from five main bases with three aircraft and two men per base. This operation continues year-round.

Average time involved is 60 hr. per aircraft per month, while the peak average is 80 to 90 hr. per aircraft each. Presently, this operation is conducted in cold weather. In addition, during the 1910 to 1938 period, the company began getting deeper into oil and natural gases work, setting up traps and supplying them for various mining companies and oil lines installed in geological areas. For this, Bell helicopters were generally used.

Pipeline Patrol

Another project in which Okanagan became involved in the early 1950s was the Trans Mountain oil pipeline between Edmonton and Vancouver, a distance of 712 mi. Okanagan had a small part in building some parts of the pipeline and, in addition, contracted to patrol the route line every 10 days.

Within two years on this operation, the statistics looked like this—total number of patrols, 355; total hours flown, 1,234 hr. 55 min.; days flown, 183; take-offs and landings, 1,415; mi. of pipeline patrolled, 50,513; reports made, 163. Results included four leaks observed and reported, 30 washers observed and repaired, five exposed major sections reported, seven dead ends reported.

In 1954 Okanagan expanded its operation and established a base at St. John's, Newfoundland, which was operated under the name of United Helicopters, Ltd. The following year, 1955, two visiting companies arrived on the coast. These were Canadian Helicopters, Ltd., of Toronto, together with bases at Toronto Island Airport, Ft. William and Custer, Newfoundland, and Saint-Amand, Ltd. of Toronto, the latter a small base operation.

During 1955, Okanagan carried out a further crossing project which took a period of four months, covered 1,751,000 acres and used 485 hr. of flying time. Ensnared were that without the helicopter, the cruise would have taken approximately five years to accomplish the same project.

From June to September, 1955, Okanagan performed its next pioneering major operation. This was called "Operation Franklin." It involved two

Sikorsky S-55 helicopters, eight Okanagan personnel, and 14 Canadian government representatives.

The effort consisted of a broad regional reconnaissance program aimed with emphasis on the determination of maps, topographic maps and structures. Mapping of the regional distribution of these features was made concurrently with local study. The work was carried out as aerial surveys in the district of Franklin in Canada's North West Territory, on the major part of the Queen Elizabeth Islands, plus the northern part of Somerset and Prince of Wales Islands, and the northwest tip of Baffin Island.

Work was conducted from five main bases. The bases were related to the number of fuel containers which had been established by the RCAF in the far North West Territory. Helicopters were primarily downed and flown to Resolute Bay as an RCAF Fandall C-119, where they were both maintained and loaded prior to jumping off for the first survey base.

All elements of these survey flights were critical. All payload planning details were worked out very closely in advance.

Each of the parties consisted of geologist and an assistant, plus the pilot, food and equipment for 14 days were



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carried. Weight of the complete party averaged approximately 700 lb. Length of stay in one location averaged four to five days. On every flight, one of the geologists would act as navigator up front with the pilot. Aeronautical charts scaled at 4 in. to the inch and air photographs were used for navigation. In addition, the geologist was going also supplied geological features on every flight. No deviations from the flight plan were made during flight without notifying base operations.

Indicative of just how critical flight planning was, fuel consumption for both machines was worked out to approximately 3.6 lb. per min. and its overall cruising speed of 70 mph. One heavy season fuel was always carried and a gross weight of 7,000 lb. was used in both machines. General meteorological forecasts were made for 24 hr. periods and local wind, however, local conditions often prevailed on route

which were not able to be forecast.

Much of the navigation was over packed ice, and had to be done by directional gyro and dead reckoning and estimated drift. Flying along coastline snow conditions and packed ice were hazardous where the snow was featureless. The danger of "white-out" was almost present.

When the parties moved from base to base, where the average distance between bases was 110 mi., except one, which was a 200 mi. jump, the helicopters were badly limited by the distance to be traveled, in the amount of extra fuel and weight they could carry. However, despite another hazard, all base changes were accomplished without major mishap.

During the operation, one helicopter flew 292 hr., 45 min., and the other, 261 hr., 48 min. Areas explored and mapped were very far from civilization, extremely new land, but well suited to



Marines Evaluate Ground Cushion Vehicle

Ground cushion vehicle for U. S. Army and U. S. Marine Corps is being developed by National Research Associates, College Park, Md., and is designated GEN-1 (Ground Effects Network). Marines now are evaluating the GEN-1 shown here. Army designation is FASH (Fast Air Support Vehicle). Vehicle is constructed of an aluminum alloy, aluminum bush (shell and internal) and doors are composed of glass fiber. Coated with aluminum, a 10 in. shell around the vehicle to provide forward, backward and lateral movement, power is from two 40 hp. Triumph petrol engines, one fore and one aft, each driving two clockwise and clockwise 42 in. diameter propellers. GEN-1 operates at 9 ft. air altitude, design speed is 18-26 mph. Vehicle is 14 ft. 7 in. long.



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Lightplane Licensed for Flying in Japan

David Hedder, Japanese regional manager for Civil Air Transport, is shown at Haneda International Airport with his Cessna 172, first plane licensed in Japan for operation by a private owner. All other lightplanes in Japan are operated by business firms. Cess 172 was shipped to Tokyo by boat from Los Angeles, Calif.

helicopter operations in fact, at least no high temperature was encountered. On the adverse side however, the problem of visibility, snow, and local weather phenomena such as fog or open patches of water, made the operation less than optimum.

Okiwara bought his first Sikorsky S-55 for work on the Mid-Canada Radar Defense Line. One of the reasons was that part of the contract involved building generators which weighed approximately 3,000 lb., well beyond the capability of the Group's Sikorsky S-55 machines.

Since then, in addition to the Palmdale powerline, Okiwara has found a number of jobs for this machine. First, that even more will be coming along is shown in the purchase of the two additional S-55s.

One job for which the S-55 was used was on the St Lawrence Seaway, where it was used to help accurately measure the depth of the river at the Lac Beauport. Here, boats run inefficient and helicopters had to be used.

The operation called for the S-55 to hover at a specific altitude. A 500 lb. weighted cable was dropped to the bottom of the river, and a triangulation was made from the shore on each side to the helicopter to accurately ascertain the depth of the rapids in this area.

Over the years, Okiwara has learned a number of operational techniques which have contributed to the company's success. Also, the company has developed, in certain cases, special equipment suited to the helicopter and its mission, although for most jobs ordinary non-operated equipment has been used.

An example of their learning can be

seen in the Palmdale purchase job for Southern California Edison. Here, Okiwara had learned, to fly the S-55 at less than maximum gross weights. This actually would be being more efficient in the long run, in that less than maximum loads are easier to land on the ground, in light and load and unload. Therefore, during an overall period of hours, the greater efficiency made it possible to fly more trips than if maximum gross weight had been used each time. Consequently, for one gross weight of hours, the total amount of flight needed was greater than it would have been had maximum gross weight been used on each flight.

In addition to saving a greater total of mileage of material in a given number of flying hours, the lower gross weight operation increased safety and lowered strain on pilots as well as on the machine. This cut the overall cost since there was less wear and tear and maintenance time necessary on the helicopter, and also the attention rate was increased.

While average loads weighed in the area of 3,000 to 3,200 lb., at times the S-55 carried up to 3,600 to 3,700 lb. On the Palmdale job, turbulence in the hills and the high descent temperatures also combined to make it impossible to operate at maximum gross weight consistently, another factor in the operation.

Okiwara emphasized that it is a very few hundred pounds at the high end of the gross weight scale which can make the critical difference in the operation. Still, the average payload carried was over 3,000 lb., considerably higher than any other machine could haul.

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MODEL 50P2 (left) shows has same type mounted as not against pyrometer. Model 50P1 (right) shows, however, same for power monitoring.

MODEL 50P3, right shows, has same 4" face dial and same mounting as our aircraft panel indicators. They are fully guaranteed and available in standard types 1000, with suitable thermocouple materials.

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Alouettes Fly Coast-to-Coast in 36 Hr.

Two Alouette II helicopters, shown being delivered by Bill Littlefield (left), Republic's Helicopter Division general manager, to Fred Lenoir, Coast Rotors, Inc., flight operations director, flew from Republic's Long Island plant to San Diego in about 36 flying hours. Trip was made in 16 legs, from Tulsa, Okla., on, headwinds were about 40 kt., because 63-66 kt. in mountain country, according to Lenoir. Coast Rotors will operate the Alouettes for offshore travel and other use (AVW Nov. 2, p. 27), complete last time in next six weeks.

had to be brought to the tower at the destination site in addition to being hooked on initially at the base. Where the helicopter is able to have a slight roll at takeoff and landing, lighter gross weights can be handled. Where the tower is weak, lower weights are required. On the Edison job, Okanagan's S-18 carried one-half cubic yard of concrete plus a 300 lb steel bucket, per flight. The helicopter could have carried an approximately heavier load of concrete per flight, with the proper constraints. However, the bucket was the same heavy steel one used in earlier Southern Cal Edison current pouring experiments.

Following pouring of the concrete, Okanagan S-18 was used to carry in and rebar the gas pole at each tower site to an altitude of approximately 70 to 80 ft.

It was much easier than doing it by hand, after the gas pole had been carried in by helicopter in two parts. It

required approximately 3-4 min to raise the pole.

All helicopter operations require a team, primarily the pilot and ground crew, in combination with the crewman who rides in the lower cage compartment of the helicopter, called the belly man. Here, Okanagan has frequently trained the client's personnel to the required skills for ground work at the load site. However, at the drop site, an air crewman is required, usually an Okanagan pilot.

Load Release

At the drop site, the belly man directed the pilot to the proper spot to release the load. This was because at some sites, located on ridges or mountain tops, the team on the ground was completely invisible to the pilot during the hover while the load was released. Consequently, accuracy in placing of the load was dependent on the crew

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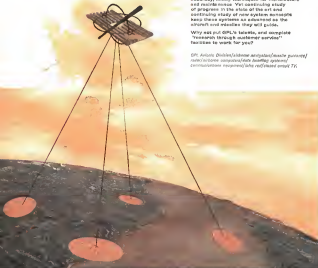


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Combining state-of-the-art equipment in several fields to create new and superior systems for search and missile guidance is still another GPL capability. One case in point is GPL's Airborne Inertial/Gauger A.I.D. navigation system—a radar-mounted, doppler-tuned and damped inertial system—in which each element carries the others, and the system as a whole provides far greater inherent accuracies.

A.I.D. and other combined guidance and integrated systems, now under development at GPL, are particularly significant because they utilize existing systems and elements, existing computer-aided processing and economy, existing techniques for manufacture and maintenance. Yet continuing study of progress in the state of the art and continuing study of new system concepts keep these systems as advanced as the search and missiles they will guide.

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down in the cargo compartment. Lack of close terrain for pilot visual reference is how it also made the job harder.

On this type of approach, where the drop site must become visible, pilots made these approaches in a sideways attitude rather than head on, since this way the pilot is able to keep the air and people in view longer than he can should he approach head on.

Another problem which has developed on occasion during Okanagan operations, especially with the S-55, is the timing of dust at either drop or landing site. Here, experienced men on the ground are vital.

Problems such as dust, sand and gravel being thrown into the air by the helicopter's downwash, has pointed out another important operational aspect to Okanagan. "This is proper site selection for flight pickup and drop locations.

Site Choices

Involved here are such things as the approach and departure flight paths, the ground itself, whether it has grass, or some other cover which prevents dust and sand blowing up during the operation.

Choice of a bad site increases costs, Okanagan has found, as well as increasing the danger to the machine and personnel involved.

This has indicated that helicopters are best used during an operation when a helicopter pilot and operations man are brought into the planning of the operation early—if possible, from the very beginning. In this way, the use of the helicopter can be tailored to the job, with optimum sites, flight paths, and planning, etc. figured ahead, by those who know the helicopter's characteristics and limitations. Knowing all the idiosyncrasies of the helicopter enables the pilot and operations man to make the customer's effort simpler as it is possible to the unique capabilities of the machine, thereby doing the best job for him at the lowest cost.

Experience also has shown Okanagan, as well as other helicopter operators, that small, in a types of machines are needed on most jobs. One is the big, weight-lifting Sikorsky type and the other is the smaller Bell type, for movement of personnel and light supplies. The Bell serves as a rescuer, capable of carrying people in the site, parking there while the main loading and unloading is done, and its pilot serves as the drop site ground man, then flying on to the next site. For the Edison operation, the Bell helicopter was supplied by a U.S. private contractor.

Not only did the Bell machines carry the personnel and light loads, they also served to earn the lead line, a small diameter aircraft type cable over the powerline. After the trail had been in

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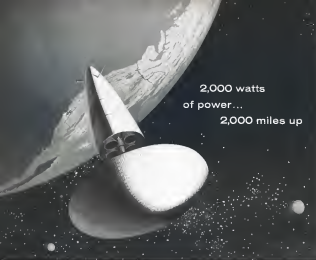
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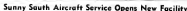
Typical solar energy converter. A panel of solar cells of approximately 20 square meters can produce 2,000 watts of electricity.

Hoffman silicon solar cells, used in these converters, are the most practical and efficient means yet developed for converting solar energy into electricity. Already proved in the U. S. Navy's Vanguard satellite, Hoffman solar cells will continue to power its radio transmitter as long as it orbits the earth.

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De Yocco thinks that Brazil shows the greatest potential for helicopters because of the large industrial and development programs just getting started in that country.



Large hangar and administration building are main structures at new Sunny South Aircraft Service area at Fort Lauderdale, Fla. (AW Oct. 5, p. 69). Facility cost \$325,000 and includes 15 bays. Sunny South, Coral Gables, was at 1978 was well over \$1 million.

AVIATION WEEK, November 16, 1958

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Bell 47G-3 Shows Altitude Capabilities

By Edwin J. Balban

FL. Worth, Tex.—Combination of a new Franklin supercharged engine and rotor system from the Model 47-J four-place helicopter gives the new Bell 47G-3 utility helicopter an ability to leave its design maximum gross weight to high altitudes with a sufficient power reserve providing high margin of safety.

In demonstration of a prototype 47G-3 at Pikes Peak, Colo., the new rotor wing aircraft showed it could lift a load equivalent to its own empty weight—1,535 lb.—from the 14,110-ft elevation. During the test, the density altitude at Pikes Peak actually was 15,400 ft and the aircraft made landings earlier at a 17,500-ft density altitude.

Tests also demonstrated that the 47G-3's supercharged 6V8-385 engine will maintain necessary power to hover the aircraft at a maximum gross weight of 2,550 lb. at altitudes as excess of 16,000 ft. The engine actually is certified to deliver 225 hp at 3,100 rpm to 10,000 ft. The 47G-3 trial showed that this rating is extremely conservative since it apparently maintains power at some 6,000 ft. or more higher altitude.

Automation Shown

Demonstrator pilot Al Averill capped the trials by making an autorotational landing on Pikes Peak, flying solo, with the aircraft at approximately 2,200 lb. gross weight, cutting power during the last approach at about 980 ft. altitude while in a 90-deg. turn.

Even margin of power, together with lost disk landing provided by the larger rotor, should take the strain of pilots operating the new helicopter even at



LONGER tail boom (14 in. extended) is visible in this flight view of the Bell Model 47G-3 helicopter hovering over 14,110-ft. Pikes Peak, Colo. Spline, which compensates for the larger rotor, is the dark pointed tubing between the landing gear from and the white pointed tail boom.

Bell Model 47G-3

| | |
|-------------------------------------|-----------------|
| Empty weight | 1,590 lb. |
| Unladen load | 1,011 lb. |
| Gross weight | 2,550 lb. |
| Forward | 900 lb.-plus |
| Hovering ceiling | 21,000 ft.-plus |
| Steering ceiling (in ground at) | 15,000 ft.-plus |
| Hovering ceiling (out of ground at) | 14,500 ft.-plus |
| Maximum cruise speed (mph) | 125 mph |
| True speed (15,000 ft.) | 119 mph |
| Maximum range | 236 mi. |
| Maximum endurance | 5 hr. plus |
| Fuel capacity (180 gal.) | 41 gal. |
| Rate of climb (15,000 ft.) | 780 fpm |

* Specified by installed rotors (Franklin 36) and used at Pikes Peak conditions. Franklin is checking performance of 6V8-385 engine using 36 octane, for possible use in emergencies.

gross weight at high altitude. The 37-in. diameter rotor of the 47G-3 provides a disk loading of 2.57 lb./sq. ft., compared with the 2.55 lb./sq. ft. for the 47G-2. It is such that at 3,000 ft., a descent for autorotation would just about stop the rate of descent and after this maneuver, there would still be ample collective pitch available for a normal landing. Averill explained.

Combustor Heat

He also noted that all through the test program on the 47G-3 thus far, he has never found it necessary to use combustor heat, indicating that the supercharged engine presents favorable inlet-air characteristics.

Early results of the test program were so favorable that when Bell decided to try the aircraft at Pikes Peak, it rushed nearly a dozen helicopter operators to witness the trials and fly the machine

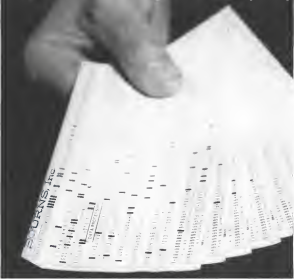
Several made flights with useful loads exceeding 1,000 lb. and several climbed over 17,000 ft., landing on Pikes Peak.

One operator said that he believed that with the reserve power available, the aircraft could cruise and land a 3,000-lb. useful load at 20,000 ft. altitudes. A Bell test pilot said that he doesn't know what the actual ceiling of the aircraft is, but he believes it probably can exceed 20,000 ft. At Ft. Worth, Tex., prior to the Colorado program, the prototype realized more than 21,000 ft. density altitude with power to spare. Outside air temperature was approximately 17-18°F.

Certification Tests

Bell now is undergoing a Federal Aviation Agency certification program and expects to have the first production 47G-3 available for delivery next March. Since the aircraft was developed entirely

TRIMPOT® RELIABILITY IS IN THE CARDS



Trimpot production: The cards summarize extensive environmental tests which Bourns regularly conducts, plus and beyond regular quality control. In Bourns' own Reliability Assurance Laboratory, working samples are taken at random from factory stocks and completely tested for conformance

Test information pushed in the cards can provide detailed performance reliability statistics on

to all environmental and electrical specifications on Trimpot catalog sheets. Results can then be fed into IBM computers which assign performance data with corrective action taken immediately, if required.

This program is the only one of its kind in the industry. Only Trimpot potentiometers are tested so thoroughly, so frequently. In short, Trimpot reliability is a fact—see you can put in your next order.

PUNCHED CARDS ARE USED TO TABULATE BOURNS RELIABILITY DATA FROM— Complete Quality Control Like This...



Trimpot reliability starts at the beginning. Here an incoming lot of potentiometer test-units undergoes a dimensional check.



From the time the element is wound until the 10 of the potentiometer is installed, in-process inspection maintains quality.



100% final inspection is made possible by this exclusive high-speed system developed by Bourns to test all major electrical characteristics. Critical dimensions of each unit are also checked.

And Reliability Assurance Tests Like These...



This shifter for measuring conformance to Mil-Spec is an integral part of the extensive equipment in Bourns Reliability Assurance Laboratory.



This chamber subjects potentiometers to elevated military tests for humidity, provides important feedback on product performance.



1000-hour load life testing per Mil-R-15A takes place in events like this, which hold temperatures at desired levels at full rated power.



When tests are completed and the results tabulated, Bourns engineers plot frequency distribution curves from the steady flow of test results. Analysis of these curves and other data from testing provides a continuing check on all models to see that they meet the most exacting standards of performance. This analysis and the constant flow of information between the Testing and Production Departments is your assurance that the Trimpot potentiometers you specify and purchase will meet specifications.

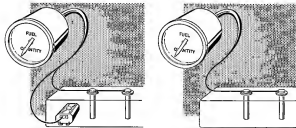
Write for the new 8-page folder describing the Bourns Reliability Assurance Program and a map of the Trimpot Summary Brochure.

**BOURNS
Inc.**

270 Elm Street, Riverside, Calif.
Phone: (415) 344-1000
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Exclusive manufacturer of TRIMPOT® Trimpot in potentiometer handovers for position, pressure and acceleration.

Why TRUE WEIGHT fuel gages on the DC-8 provide GREATER ACCURACY



Liquidometer True Weight Gaging Systems sense the dielectric and density of aviation fuel as two independent variables. Volume is measured by tank units and a reference condenser, density by a LIQUIDensitometer*. Controlled by these measurement signals, the Liquidometer system provides the pilot with a direct indication of the true weight of fuel remaining.

Conventional gaging systems, on the other hand, depend upon the unpredictable relationship between the dielectric and the density of fuel. This relationship varies widely among different batches of the same fuel and, when plotted, appears as a cloud of points rather than a single precise line. Thus, conventional systems, incapable of measuring density directly, can only approximate the weight of fuel remaining.



Since 1920

THE LIQUIDOMETER CORP.
LONG ISLAND CITY 1, NEW YORK

*Infrared

Liquidometer True Weight Gaging Systems—service proven on thousands of military aircraft—are scheduled for first commercial service on UNITED AIR LINES DC-8 Jet Mainliners and later for ALITALIA • JAPAN AIR LINES • KLM-ROYAL DUTCH AIRLINES • SAS SCANDINAVIAN AIRLINES SYSTEM • SWISSAIR • TRANS-CANADA AIRLINES • UAT UNION AEROMARITIME DE TRANSPORT

with computer banks, it would be available immediately for the civilian market.

Company officials declined to set a firm price on the new model, but indications are at the present moment it will probably be under \$40,000, or less than \$5,000 under the price of the 1960 Model 47G-2, which the company is continuing in production.

Basic configuration is very similar to the 47G-2 model, but the 47G-3 will have a tail boom 14 in. longer than the earlier model to accommodate the oversized rotor diameter. Model 47G-2 rotor diameter is 55 ft. Many of the 47G-2 parts will be interchangeable with the new model. The new aircraft also will have the Model 47T's tail rotor blades, but it will be the 1960 Model 47G-2. Indications are that some opera-

tion with later Model 47G-3s could have their rotors converted to 47G-3 configuration, although at this time Bell says that nothing has been worked out on such a modernization program.

Texans Plan Airport For Executive Planes

Dallas, Tex.—Mellotron defense executive aircraft airport and industrial center is being planned for the Dallas-Ft. Worth area with completion of Phase I scheduled by next summer.

Master plan's first phase envisages elaborate business plane facilities on a 768-acre site south of Ft. Worth, with a 6,000-ft. runway, two 3,000-ft. runways, a dozen large hangars and 24 smaller hangars. An airport terminal

building with 52,990 sq. ft. of space also is planned.

Among early acts will be erection of a 125-unit motel.

Corporation which will handle development of the installation is Splice, Inc., composed of a group of Texas businessmen. Splice, Inc., says that the new facility also will be the home of a new research and development organization being formed by the corporation, which will operate in missile, space and electronic work.

A plane manufacturing plant—which would initially produce a two-place light aircraft—also is being considered in the master plan. Completion of the final phase of the facility, including laboratories and the aircraft factory, would be in late 1962, according to Splice, Inc., spokesmen.



Swiss Pilot Demonstrates Polish Jaskolka Sailplane

Polish SZD-30a Jaskolka sailplane, shown here in Swiss meetings and flown by Swiss pilot R. Wick, is a high performance design of all wood construction. Wick demonstrated sensitive and high speed capabilities of the aircraft at a display marking the 50th anniversary of the Geneva, Switzerland, Flying Club at Colonne Airport. Towed to about 2,000 ft. by a Dewoitine D-335 vintage twin and French high wing powered lighter plane (below), Wick entered an aerobatic routine elevated by a low altitude pass (above). Jaskolka (twofold in Polish) holds record world records for speed and distance. Wing span is 52 ft. 6 in. and maximum gross weight is about 750 lb. But glide ratio is better than 25:1 and maximum sinking speed is about 2.5 ft. per second.



G. E. INERTIAL PLATFORMS shrink missile readiness time to 60 seconds at -55°C



In the event of attack...we cannot expect more than minutes warning and minutes to retaliate. Therefore...inertial systems in air-launched missiles required as much as thirty minutes warm up time before operation and an additional amount of time before achieving specified accuracy. The new G.E. Platform is designed specifically to give satisfactory performance over a wide range of temperatures in high G environments.

It is smaller in size and weight than similar platforms and the following features are indicative of the performance to be expected:

1. Fully operable within one minute after power is applied
2. 20 minutes after -55°C start-up achieves accuracy as specified
3. Ambient temperature -55°C to +100°C.
4. Tolerates high acceleration environment.
5. Functions and associated electronics total only 55.7 pounds

This lightweight ruggedized environmentally suited platform is ideal for long range air launched missiles. The unusually low drift rate eliminates the necessity of "trimming" or adjusting the gyro before each mission.

More complete details are available on the system by contacting Managers—Control Sales, General Electric Company, Light Military Electronics Department, Armament and Control Section, Johnstown City, N. Y., Dept 12F.

GENERAL ELECTRIC

LIGHT MILITARY ELECTRONICS DEPARTMENT
FRENCH ROAD, UTICA, NEW YORK

Soviets Favor Czech Morava as Ambulance

Ross, Czechoslovakian-Soviet Russia has found the Czechoslovakian Morava touring or ambulance aircraft superior to the Antonov An-141. But, according to Chicago, the foreign trade company in charge of export trade of Czech aircraft and associated products.

The L200 Morava A, latest version of the L200 Morava touring or ambulance aircraft built by the National Aircraft Works, Krasno, Czechoslovakia, was shown at the airport trade fair here (AVN Oct 19, p. 90).

First model of the Morava flew for the first time in April, 1957, and the Czech airline Cotylovaevia Airlines has been using increasing numbers of this type for the last two years for air taxi duty.

Russia, which bought and tested a few L200 Morava aircraft that year, is expected to place a large order for the improved version as soon as it becomes available for export, scheduled for next year.

The televisioned Soviet L200 Morava was designed by Czech engineer Ladislav Stankovic who also designed the Super Aero touring and night-purse aircraft now flying in 25 different countries. Russia alone purchased a total of 250 Super Aero for Aeroflot. The new version on show at Ross was powered by two air-cooled, six-cylinder M-317 fuel injection engines with superchargers as a replacement for the two 360 hp. Walter Minor 6-311 engines which previously powered the Morava. Maximum power of the M-

L200 Morava A Data

| | |
|----------------------------------|--------------------|
| Dimensions | |
| Span | 39 ft. 4 in. |
| Length | 25 ft. 3 in. |
| Wing area | 186.17 sq. ft. |
| Chord | 4.6 ft. |
| Height | 4 ft. 11 in. |
| Length | 4 ft. 31 in. |
| Weights | |
| Empty weight | 2,647 lb. |
| Gross weight | 4,675 lb. |
| Maximum takeoff weight | 4,752 lb. |
| Takeoff load | 1,378 to 1,543 lb. |
| Performance | |
| Maximum speed | 173 mph |
| Cruising speed | 173 mph |
| Climbing on two engines | 31,853 ft. |
| Takeoff distance | 721 ft. |
| Takeoff distance to clear | 49 ft. |
| Landing distance | 1,034 ft. |
| Landing distance | 828 ft. |
| Rate of climb | 6,941 ft. |
| Fuel consumption on normal power | 1,055 gal. |
| | 7.5 gal./hr. |

FACTS the aviation industry should have on commercial uranium

Uranium has many interesting properties.

For example, Dense Uranium has compressibility — 50% greater than steel and about equal to gold. This indicates savings in component weights in aircraft, shipbuilding, and making industries — wherever high weight and low volume are factors. It also readily with many oxides including aluminum, chromium, copper, iron, manganese, molybdenum, sodium, nickel, silicon and titanium. Corrosion resistance is increased when uranium is alloyed with one of these metals. Dense Uranium possesses high elastic strength and high thermal expansion. While fairly hard (Brinell 240) at room temperature, uranium becomes very ductile as temperature rises. At 1190°C, its hardness drops to about 20.

Is Dense Uranium easy to fabricate?

Dense Uranium may be melted and cast into any desired shape. It may be formed by extrusion, drawing, rolling, swaging, pressing or forging.

You can machine Commercial Uranium with conventional uncooled machine tools, knowing at once that it has work-hardening characteristics similar to those of steels and cast.

How about welding?

Success in welding Dense Uranium has been achieved using the Helarc arc shielded arc-consumable electrode process. At this time experiments continue in joining uranium to steels by braze or soldering.

How has Commercial Uranium been used?

Present applications in the Aviation Industry are counterweights and static balances. Applications in other industries include shielding controls, telephonic heads, neutron counters. And for many years, uranium has been used in color screens and glass.

Is Dense Uranium safe?

Radiation hazards are minor. AEC tests indicate a small exposure to depleted uranium is only about 1/1000 to 1/10000 the radiation received from an ordinary chest X-ray.

Must special storage precautions be taken?

Uranium metal (except fines) can be melted and stored with methods similar to those used with any other reactive metal. First, however, are flammable and should be stored under oil or water.

Is Commercial Uranium expensive?

Yes in all. For example, in less of 1000 pounds or more Commercial Uranium is priced at just \$4.00 per pound — considerably cheaper than other heavy metals, with the advantage of superior density.

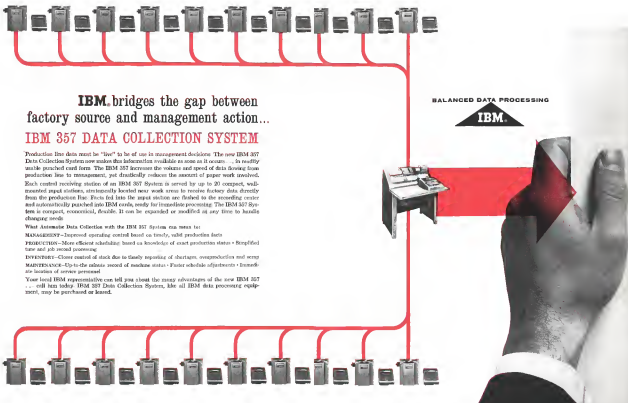
Need more information?

A letter will bring you additional data for the application of Commercial Uranium to your product or process. Write today to Department D108, Evans, Tennessee.

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ERWIN, TENNESSEE





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factory source and management action...

IBM 357 DATA COLLECTION SYSTEM

Production line data must be "live" to be of use in management decisions. The new IBM 357 Data Collection System now makes this information available as soon as it occurs... in readily usable punched card form. The IBM 357 increases the volume and speed of data flowing from production line to management, yet drastically reduces the amount of paper work involved.

Each control receiving station of an IBM 357 System is served by up to 20 compact, wall-mounted input stations, strategically located near work areas to receive factory data directly from the production line. Facts fed into the input station are flashed to the recording center and automatically punched into IBM cards, ready for immediate processing. The IBM 357 System is compact, economical, flexible. It can be expanded or modified at any time to handle changing needs.

What Automatic Data Collection with the IBM 357 System can mean for:

MANAGEMENT—Improved operating control based on timely, valid production facts

PRODUCTION—More efficient scheduling based on knowledge of exact production status • Simplified time and job record processing

INVENTORY—Closer control of stock due to timely reporting of shortages, overproduction and scrap

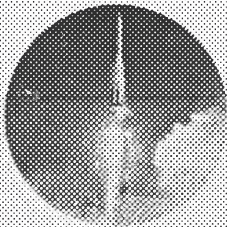
MAINTENANCE—Up-to-the minute record of machine status • Faster schedule adjustments • Immediate location of service personnel

Your local IBM representative can tell you about the many advantages of the new IBM 357... call him today. IBM 357 Data Collection System, like all IBM data processing equipment, may be purchased or leased.

BALANCED DATA PROCESSING

IBM





There are 7,000 dots above here.
This is the number of engines in the
eight divisions of Martin. And 40 percent
of those—the 2,800 dots in the oval—
are electrosynthesized engines.

It is this specialized
capability that enables Martin to develop
electronic systems which anticipate the
ever-changing demands of the aircraft space age.

Example: A Martin electronic
system known as Master Operations Control (MOC)
has been a vital factor in the exceptional performance
of TITAN. By automatically
directing the hundreds of systems necessary
to successful flight,
MOC has increased each of the Titan crew
from complicated coordination problems.



The world divisions of The Martin Company are
Arlington, Bethesda, Chevy
Chase, Fairfax, Gaithersburg, Littleton, and St. Louis.

137 cubic in. 210 hp. at 2,550 rpm.
maximum continuous power is 175 hp.

Both the M 137 and another new
propeller, the M 132 of 140 hp. at
2,500 rpm., were introduced and tested
preliminarily at the Bos trade
fair in the latest types of Czech aircraft
engines designed for small sport and
transport aircraft.

The 1,200 Mustang A is available in
two versions as a five-seat touring plane
or as an ambulance capable of carrying
two patients on stretchers, the pilot and
a doctor.

The cabin, which has a hot air in-
stallation can be entered from both
sides through doors opening in flight
direction. There are two baggage com-
partments, one behind the rear seats
for small items, the other all of the
cabin and accessible only from the ex-
terior.

The electrically operated V 410
metal propeller is directly driven and
has two different pitch settings which
can be controlled during flight.

The fuselage is of aluminum, semi-
monocoque construction. Floor and
both saddles are fitted with true ribs.

All metal, two-way wings have Frac
type ailerons and hydraulically operated
flaps with an electric position indicator.

The movable, retractable landing gear
of the aircraft is hydraulically operated,
retracting in a downward direction.
Main wheels are fitted with hydraulic brakes,
and both landing gear and flaps also have
an emergency hydraulic system actuated
from a hand pump.

The main fuel tanks are located on
the wing tips and auxiliary fuel tanks
are in the wings. Fuel valves enable
feeding either engine from any tank.

The aircraft has a liquid propeller
driving system and the wing leading
edges are also protected against ice,
although Daimler did not explain how
this is achieved.

Electric power is delivered from two
100-watt generators and a 30 amp/hr.
battery. The battery enables the en-
gines to be started when necessary with-
out the aid of an outside power unit.

Full blind flying equipment is an
optional extra.

PRIVATE LINES

Just recently delivered the 7,000th
Pittsboro semi utility airplane, a Super
Club supercharger, to J. Schaller, Gen-
eral America.

Delaware is now chosen for Beech
Aircraft Corp.'s new four-place Model
13 business plane (AW Sept. 18,
p. 11), on which production deliv-
ery began this month.

Two B-111C 12E helicopters have
been delivered to Mexico's government.

ANNOUNCING A NEW DEVELOPMENT BY BENDIX



FOR TURBINE ENGINES

Provides a continuous condensed display of turbine engine vibration and temperature conditions

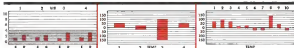
A landmark in engine instrumentation progress is the Bendix® Temperature-Vibration Monitor which continuously displays the readings of 40 temperatures and 8 vibration sensors (exceptably located on all 4 engines of a turbine-powered aircraft). This data is presented on the flight deck of the aircraft in bar graph form so that it can be continuously monitored and easily read.

The average displacement of 8 vibration pickups is displayed continuously on the lower cathode ray tube with the top of the bar graph indicating vibration displacement on the end scale. This continuous monitoring of vibration immediately indicates excessive vibration on the jet engines.

The temperature analysis normally associated with the exhaust gas thermocouples will locate faulty burners, hot combustion distribution and plugged nozzles or any unusual hot or cold

conditions around the turbine engine exhaust. The temperature display in the "all" position presents maximum and minimum temperatures on the upper cathode ray tube continuously for the four engines as reference to a temperature datum set in by the operator. The individual engine temperatures can be displayed as 16 bar graphs whose deflection can be read on the tube scale in deflections above or below the temperature datum, and individual degrees may be accurately and easily read from the digital read-out dial.

The equipment, initially developed for BOAC, is applicable to all airline and military turbine-powered aircraft. The equipment for the four engine installation is approximately 30 lbs. and includes the Temperature-Vibration Monitor pictured above and a recently conceived 14 ATR chart box.



Vibration deflection for four engines with first and rear pickup on each. Height of display indicates total vibration displacement.

Temperature "all" display indicating maximum and minimum temperatures above and below temperature datum for four engines.

Temperature for single engine indicates all thermocouples including temperature above and below temperature datum reference.

Scintilla Division
2027 NEW YORK



owned Perdomo Mexicana (PEMEX) for transport of personnel and supplies to offshore oil rigs in the Gulf of Mexico and to inland areas for oil and gas site exploration, storage, sand planning and pipeline patrol.

Agency Underwritten, an aviation insurance company headed by Robert Cavallaro, has been organized at Ann Arbor, Mich., to write insurance on single engine and light twin engine aircraft in that state.

VHF radio, especially designed for helicopter operations, has been placed on the market by Nova-Tech, Inc., Monticello Beach, Calif. Model HIR-1 transceiver can handle 25 channels, has a range of about 30 mi. at 900 ft. altitude. Power output is 10.2 watts. Unit, designed originally for Hughes 269 A two-place helicopter, weighs 3 lb.

Canadian government will finance a \$13 million hydro-power and irrigation canal survey at the Mekong River in Southeast Asia, offering all of Canada's principal air service companies. Job includes air photography, ground survey and construction of maps. Photographic Survey Corp., Toronto, is project manager. Companies participating are Acta Services, Ltd., Vancouver; Canadian Aero Service, Ltd., Ottawa; McElroy's Nelson Air Services, Ltd., Vancouver; Le Compagnie Photo-Air Lavoisier, Quebec City; and Spartan Air Services, Ltd., Ottawa.

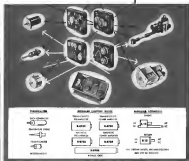
Mississippi Valley Helicopters, Inc., has received a contract from the Rutherford-Panama Co., St. Louis, to provide local helicopter service for company officials, visitors and traveling personnel between various points and Lambert-St. Louis Municipal Airport. Negotiations are under way to contract a permanent helipad on Rutherford-Panama's headquarters building road.

Customer list prices for 1966 models of three Bendix executive planes are: Super G18, \$126,000, an increase of \$1,500 over last year; H10 Twin Bonanza, \$85,000, up \$1,000; and D70C Twin Bonanza, \$55,600, up \$2,300.

Initial public offering of 100,000 shares of common stock of Southwest Aerospace Corp., Dallas, Tex., begins street sales and a price order, was announced. Offering started at a asking price of \$4.75. Half of the income went to Southwest Aerospace's treasury and half to company officials dispersing of portions of their holdings. Over-the-counter offering was handled by an underwriting group composed of Rutch, Pierce & Co., Inc., and Dallas Repp & Sons, Inc., both of Dallas.

Now—Modular Control Systems

Now Airborne streamlined control design time, helps you get faster delivery



Result of Airborne's new modular control systems is a streamlined control package consisting of a standardized cable of 2 x 9 or 3 x 9 pins which connects prepackaged and power supply subunits are plugged. Amplifiers from subunits having more than one output can be plugged into the cable. The cable is designed to be plugged into the cable of the control system in minimum time.

Over the past 6 years, Airborne has designed and produced a number of special electromechanical control systems for aircraft engine oil. While these have differed in their functions, many of them have nevertheless employed essentially similar components. Thus our policy has been to seek increasing standardization of parts through modular design—in the sense where we can now offer complete systems engineered under this concept.

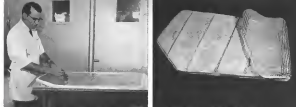
From transducer through actuator, these new Airborne systems are assembled entirely from standardized, interchangeable components. For many applications, you can de-

sign through these packaged systems as they stand—and thus reduce engineering time, lead time, and costs. In other instances, slight modifications of the modular units provide the basis for immediately available systems.

Get complete information on this latest Airborne development by requesting new Bulletin PS-3A. If you find your requirements are unique and cannot be met with standard units—however flexible—we still think your inquiry. As mentioned, Airborne offers an extensive standard in custom systems for temperature control, servo control, and positioning.



Engineered Equipment for Aircraft and Industry
AIRBORNE ACCESSORIES CORPORATION
HILLSIDE 5, NEW JERSEY • Offices in Los Angeles and Dallas



Fluor negative is coated with chemical-resistant masking compound (left); at right rolls is pulled from the honeycomb.

Northrop Uses Chemical Milling for Honeycomb Shape

Northrop Corp.'s Santa Barbara Division has developed a system of chemically milling honeycomb structures for production of difficult contours, such as inside double canted ribs. Form shown on this page is a leading gear that does for Northrop T-38 Talon weapons jet trainers. Process is being adopted for production use by Chrysler Division of Turbo Products, Inc., Warren, Mich., and will be a major segment with Northrop. Method consists of pressing a block of expanded honeycomb into a die, then using a plastic like "Acetone" representing the reverse side of the contour, then making the exposed portion of the honeycomb cells and dissolving "negatives." Exposed portion of the honeycomb is then removed by chemical milling. A plastic compound—Tur-

form Mesh 150—is used to coat the negative, applied at room temperature by brush or spray. Alternates: 9012 and 9002, steel 157 and 159 honeycomb cores have been milled by this process. On production run, tolerances of plus or minus .005 have been achieved with steel and aluminum cores, plus or minus .003 with aluminum and 061 with steel. Company said the Talon does does about 16 in. wide, 50 in. long and 16 in. thick has a total milling cost of \$800 for chemical milling, compared with \$3,500 for machining and coating processes of forming. On a five per cent quantity run of a total production quantity of 10, the chemical milled unit would cost \$350, a new Northrop compared with \$600 for the same unit produced under the traditional and milled method.

Contoured honeycomb core is shown below with matching aluminum skin after completion of the chemical milling process.



AERONAUTICAL ENGINEERING

Curtiss-Wright Demonstrates VTOL

Santa Barbara-Curtiss-Wright will fly its VZ-7AP Army VTOL test vehicle some 33-35 ft. in proving feasibility of the single engine, four-rotor configuration which was designed to require only taking for a quarter ton of weight or cargo or horsepower payload, a speed of 10 mph. and a 30 min. flight duration.

Curtiss-Wright's testbed demonstrated here, publicly for the first time recently, has been popularly dubbed an "air jet" along with similar projects at Panavia Aircraft Co., and Chrysler Corp., since specifications for the actual ground vehicles to respect to speed and load are very similar. The Chrysler Corp. project was canceled after the vehicle crashed (AW Sept. 28, p. 29).

Longest flight time recorded so far by the vehicle is 25 min., and sufficient fuel was left to achieve the design time, Curtiss-Wright indicates. During the public flight demonstration, observers noted that Curtiss-Wright test pilot C. Roger Gardner appeared to have no trouble controlling the vehicle, despite its apparent extreme sensitivity. Gardner said the machine is "amazingly stable."

Vehicle Funding

Vehicle currently is operating on funds supplied by Army Transportation Research and Engineering Command (TRECOM) under its original contract. However, when these funds are exhausted, there will be no more from TRECOM. Funding ended in September but if the program is even fully carried further, funds will be supplied by the Army Transportation Corps.

Although there have been no concrete formal operational vehicle design, Curtiss-Wright has sketched several based on the four-rotor configuration for various missions at various gross weights. Analyzed are several with payload above the cabin, rather than below, as on the testbed. General design are predicated on a payload to gross weight ratio of 25%.

VZ-7AP Development

VZ-7AP development began at Curtiss-Wright in early 1957 when a proposal was made to Army in answer to an Army specification which was originated by the Infantry. Work under a contract was initiated in mid-1957.

Four-rotor design of the VZ-7AP is credited to Dr. Richard Vogt of



CURTIS-WRIGHT Army-sponsored VTOL test vehicle, VZ-7AP, flies during its latest public showing. Pilot Roger Gardner flies the four-rotor machine while four support teams during the demonstration, for a total flight time of more than 35 min. During the demonstration the vehicle was flown forward, on the down, and to left and right laterally. It also was flown to approximately 12 ft. above the surface of the ground (base which is generally but only about 10 mph at forward speed). The vehicle so far has approximately two hours in actual flight time although coming time of the engine, per two and, payload at operational speeds exceeds 14 in. Flight time on these missions is covered by helicopter and various standards, that is, all testing time is counted after that actual off the ground flight time. Curtiss-Wright also demonstrated its Skydax target, Turbulence turbine and Downer model aircraft system.

Curtiss-Wright's Santa Barbara Division. According to Dr. Vogt, the four-rotor, propeller configuration was chosen over four ducted or shrouded fans for several reasons.

While a shroud will increase lift, it also has an increased resistance drag. Dr. Vogt indicated also, in several pitch oscillations, the first period is six seconds and amplitude is increased by a factor of six to the fourth oscillation in the undamped or uncontrolled condition. However, for the unshrouded configuration, the period is 18 sec. and amplitude expansion is only by a factor of 1.2 to 1.3 at the next for the same number of oscillations.

Shrouded Configuration

Another problem, Dr. Vogt said, is the greater inclination angle required for forward flight at the design speeds. A shrouded configuration would have

to be inclined 40 deg. nose-down to 45-60 mph while the unshrouded configuration can accomplish the speed with about 5 deg. nose-down according to the designer.

Test Inspection

During the test program so far, in which testing time for the machine's gear box and propellers is more than 14 in. all running time occurs after two post airborne tests, there have been constant inspections between flights of the gears, shafts, bearings and other components of the propeller drive system, in an effort to determine an estimate for maintenance, replacement, or overhaul time on the parts of the system.

Originally the VZ-7AP had 48 in. articulated blades on the propellers, but the blades were broken off soon and only the flappers are operative. The blades are of fairly low aspect ratio—about 6—and are fabricated of Incon-



Army Caribou Transport Starts Military Tests

De Havilland TAC-1 Caribou STOL, troop and cargo transport, has started initial testing for its military applications at Edwards AFB, Calif., Flight Test Center. Phase I is one of five ordered for testing by U. S. Army (AWC Oct. 19, p. 175) and is powered by two Pratt & Whitney R2000 1,416-hp engines. Flightlog has been extended 47 in.

rated glass fiber. Propeller diameter at 30 in. and at constant rpm weight, disk loading is 15 psf.

Changes have indicated that the VZ-7AP program has gone soft, in view of the fact that there are no spare parts. Efficiency has increased to the point where for every hour of running time, the turboprop gets at least 43 min. of actual off-the-ground flight time.

Turboprop automatic pilot controls standard flight plus engine rpm, exhaust gas temperature, oil temperature gauge for engine and a pump for the main gear box plus each individual propeller gear box. A problem here is that there is only one pump and a selector switch must be used, and since both hands are needed to control the engine, gear box temperature gauge switching is done when the turboprop is on the ground.

Chip Detector

Chip detectors also are installed in the main gear box and each propeller gear box, with red and warning lights on the instrument panel, alert for the gear boxes the lubricating oil also serves as the prop shaft governor actuating fluid, and one has chip could cause trouble.

VZ-7AP is powered by a Turbo-prop Atomic II gas turbine engine manufactured in this country by Continental Aircraft and Engine Co. Engine is being run at 425 cfm for this installation and during flight, must at least 400 cfm.

Start routine of the Atomic II is self-contained; operation is accomplished simply by turning the start switch to the "on" position. Fuel control also is simple, with "off," "start" and "on"

positions. While on forward check has been made, detent cycle on for 15 sec. after the time the start switch was turned on until the VZ-7AP became airborne.

If a second VZ-7AP test vehicle is constructed, it will use the Atomic IIIC engine, which is rated at 500 hp, offering turboprop performance.

Centrifugal Clutch

Power from the engine is transmitted through a centrifugal clutch to a central gear box from which the four propeller shafts project radially. Normally, the clutch remains engaged at all times, and when the engine vibrates, rotor shaft starts. Shaft and propeller assembly weigh a 1,150 lbs., although the midline experiment has been run at normal speed 2,350 to 2,400 propeller rpm.

The main gear box, propeller shaft bearings and the propeller gear boxes are an X-shaped, rigid structure, the gear boxes of 156-T6 aluminum alloy casting, the shaft bearings of heat-treated aluminum alloy 2024-T3 channels and sheet metal. This "rigid" as it is called, when bolted to the parts of the structure carrying the pilot seat, fuel platform and fuel tanks, because the test bed permits structure. Main spool could be adapted to other structural configurations, such as those carrying a load along under the spool instead of on top.

Airframe is fabricated from sheet metal sandwich panels having clad aluminum faces being bonded to aluminum honeycomb core. Metal honeycomb is used on all surfaces of the box beam structure as well as for bulkheads. Panels are riveted at the edges to aluminum tubular and transverse aluminum alloy

angles. The rigidity and damping afforded by the sandwich construction specifically characterizes panel vibration. Centurion-Wright engineers say that a structure of this type can be assembled with a minimum of jigs and tools.

Central gear box, propeller shafts and hubs are cast and developed as a joint effort by Centurion-Wright and the Sargent Engineering Corp. of Los Angeles. Transmission system was manufactured and given sustained service tests by Sargent.

Smaller Bearings

The central gear box has two spiral bevel pinions mounted directly face to a single shaft so that gear loads are virtually canceled, permitting the use of smaller bearings and housing. Each of the two bevel pinions drive two gears which, through intermediate shafts, drive the four propeller gear boxes, inside which a pair of spiral bevel gears completes the transmission to the propellers. Propeller gear boxes contain integral hydrostatically-actuated propeller pitch control actuators. Control inputs are transmitted by the pilot through cables directly to slide valves which control the position of a piston loaded directly to the propeller blades.

Energy hydrostatically-actuated propeller pitch control system is inside the oil reservoir within the propeller hub except for the power cylinder and control valve. No lines or fittings are used in the system. Check valves, relief valves, pumps, etc., are all modular plug-in type installations. Two parallel pumps are provided, which in the oil reservoir in which dual components are used, according to Sargent.

All four propeller gear boxes are pro-

vided with self-contained, independent hydraulic systems in which the gear box lubricant also serves as the working hydraulic fluid.

Control system consists of conventional stick and rudder for controlling movement about the pitch, roll and yaw axes. A collective pitch lever, located in the pilot's seat, is used to adjust vertical movement. Power control consists only of a push-pull lever to tune on the fuel supply to the engine and a trim knob to set engine rpm. Once set, a governor holds the rpm constant regardless of engine load.

Roll Improvement

Roll movement is controlled by lateral stick displacement which in turn changes pitch of the propeller on a reciprocal basis. Thus, if the stick is moved to the left, pitch at the left hand propeller will decrease while increasing on the right pair. Similarly, yaw and roll movements of the stick change pitch of the respective front or rear pair of propellers. A collective pitch lever changes pitch of all four propellers but vertical movement while a rudder bar enables combination of yaw and roll movements to be introduced to the propeller pitch control valves.

Yaw axis control is achieved by rudder pedal movement which changes, through cables, the angle of deflection of a vane in the exhaust efflux and the angle of other vanes mounted under each of the two fans. Originally Centurion-Wright engineers desired the exhaust vane adequate for directional control, but this did not prove out in initial flight tests made Sept. 3. Only

about 75 lb. thrust in the tailpipe and proved insufficient for directional control even though there is no torque effect.

Yaw control is achieved by direct cable linkage from ladder pedals to the vanes under each fan and in the exhaust efflux.

Central gear box and each of the propeller shaft gear boxes contain their own independent oil supply and lubricating systems. It is not possible for a leak in any one system to drain the other systems, but the nature of the modification is such that a malfunction of any of the propeller intake is tantamount to immediate shutdown.

Control of gusts of the turboprop is ahead of the center of lift with the result that in hovering flight a greater load is carried by the forward pair of propellers. Project Engineer Walt Wall said that this loading is necessitated by the fact that during forward flight the front pair of propellers sustains less and less load as forward speed increases. By averaging the center of gravity to be ahead of the center of lift, load on all four propellers is more nearly equal at moderate forward speeds. In a production version, the airframe is generally regarded as allowing a greater load margin in CLG location since the pilot can make up for load loss to a fairly good extent.

Gross Weights

Gross weight of the VZ-7AP is about 3,400 lb. including pilot and 640 fuel load. Centurion-Wright says that the machine is capable of operating at sea level at gross weight of 2,950 lb., leaving 550 lb. for payload. Payload



YJ85-5 Afterburning Turbojet for N-156F

General Electric YJ155 afterburning turbojet engine for light use on Northrop N-156F "Firebird Fighter" (AWW Nov. 5, p. 95, 95) is prepared for shipment from the company's Lynn, Mass., plant. Engine is a prototype of first YJ155 that will power both N-156F and the YJ-58 Falcon trainer version, both powered by J45-10.

BASIC BUILDING BLOCKS FROM KEARFOOT



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Specifically designed for missile applications, these Kearfoot miniature gyros operate efficiently at unlimited altitudes. Their outstanding accuracy and performance make them superior to any comparably sized units on the market. Normally mounted within a thermal jacket, these gyros are readily adapted and completely designed to production methods. Performance characteristics that are even more precise can be provided within the same dimensions.

TYPICAL CHARACTERISTICS

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Max Inertia 1.1 lb./in.
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Standard Gyro Unit Weight 1.0 lb./in.
Vertical Position 0.01°/hr
Drift Rate to Acceptability 0.01°/hr
Drift Rate to Acceptability 0.01°/hr
Vibratory Acceleration 0.01°/hr/ft/sec
Vibratory Acceleration 0.01°/hr/ft/sec
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Ratio of input angle to output angle is 1:1
Characteristic Time 0.001 seconds or less
Weight 0.7 lb.
Warm Up Time 10 minutes min. - 80° F
Life 1000 hours minimum



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capacity generally is taken up by telemetry and instrumentation systems.

Tests have not been conducted to determine how much performance will be affected by altitude, but some calculations are available. Specialists have called for operational ceilings at 6,000 ft. above sea level. Altitude at which the vehicle can operate above terrain is not an important criterion, according to Wolf, but operation from high altitude terrain is important, since combat operations often involve high mountains. TRECUM does not require that the vehicle operate at any

appreciable altitude above terrain since its mission calls for short hops close to the ground. Moreover, it is actually convenient in wing tests and existing terrain features do not cover during operation.

Major reason why the VZ-7AP does not now operate very high off the ground is that the vehicle has no glide or autorotational capability, an pilot ejection seat as the method. However, it is certain that one production model would have the ejection seat, and an escape system would be incorporated in the prototype if it were to operate at any significant height.



DEVELOPMENT cost of 79 hp regenerative turbine engine exceeded \$1 million. Sam Wilburn, Wilburn Research Corp. president, expects more savings (above).

**New Regenerative Gas Turbine
May Have Helicopter Application**

Detroit—Wilburn Research Corp., Walnut Lake, Mich., has developed a low cost 75 hp, 75 lb regenerative gas turbine that may have applications for light aircraft.

For certain military applications, such as lightweight helicopters, a non-regenerative version will be available. But weight only about 50 lb. Rumored is that during the Korean War, helicopter mission averaged 10 min in length, so the added weight and cost of the heat exchanger could not be justified in its helicopter version.

The unit, which is described as being the size of a bread box, is 10% composed of aluminum alloy die castings. These castings include gas case, compressor and outer housing. Rotating

parts are made from conventional for non-alloys.

A test installation, mounted on an outboard motor in an 18 ft. Thymepace boat, has been running for 15 months.

Sam Wilburn, 35-year-old founder and president of the company, says he plans manufacture of aircraft version in about a year. The unit is scheduled to undergo FAA acceptance tests soon.

Wilburn, before leaving his own business, was a principal designer on the regenerative turboprop engine that Chrysler Corp. developed for Navy Bureau of Aeronautics as well as the latest unit now under development by Chrysler for automotive use. The latter engine utilizes a rotating heat exchanger.

**BASIC
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|-----------------------------|-----------------------|
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| Frequency Response | 100 to 120 cps |
| Supply pressure | 500 to 2000 psi |
| Temperature fluid & ambient | -65°F to +135°F |
| Flow Rate Range | 2 to 50 gpm |
| Weight | 305 grams |

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Second Prototype Avian Autogyro Construction Started in Canada

Georgetown, Ont., Can.—First prototype of a new autogyro type VTOL (VFW) 15, p. 103, designed to provide high performance with a simplified long-life structure, is nearing completion here. Work also has started on a second prototype for certification.

The Avian 2718 Gyroplane features a novel "jump takeoff" system for use in restricted areas and an emergency in event of engine failure. System basically comprises an engine-refuelable compressed air actuator which the designers report will boost several rotor blades during takeoff by a factor of five. For VTOL, jump takeoff, this system will provide sufficient energy to boost the Gyroplane to an initial height of approximately 100 ft, then add.

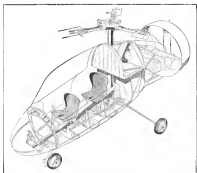
To develop long-life characteristics, Avian engineers have utilized composite employing steel in structural areas under fluctuating stresses in a composition are less than 1,000 psi, in which case high alloys are used. Avian fuselage structure and all of the rotor rim are of steel and it is anticipated that a design fatigue reserve factor of three has been achieved in effect providing an infinite life for these components, they contend.

Rotor fuselage structure comprises a vertical steel tube in the pylon and a horizontal steel tube in the keel of the front fuselage into which all loading gear loads are dissipated and to which seats and other components are attached. Landing gear strut is a single tapered spring steel rod held in a socket by a single bolt.

Rotor blade structure is all steel with a hardwood section forward of the main spar and built in the trailing edge section, with reinforced glass fiber skin covering. The Gyroplane does not use drag hinges on the rotor head in order to avoid fast harmonic flight vibration and ground resonance characteristics, also, the fundamental airplane, natural frequency of the blade is well above maximum rotor speed.

This philosophy results in a relatively heavy blade with high in-plane stiffness. Blade angle of attack is developed entirely by a servo-actuated control system, utilizing light control stick forces. High effort flying hinges are used.

The designers note that the system gives high values of initial angular acceleration and damping in pitch and roll. Maximum rate of pitch and roll is less than 10 deg/sec in low speeds.



HORIZONTAL STEEL KEEL, around which fuselage structure is assembled, takes lower Gyroplane 2718 loading gear loads. Fuselage skin is reinforced Kevlar glass. Vow tested in heated air of ducted powder propeller. Gyroplane will cost about \$10,000 and is being built by a group of former Avco Aircraft, Ltd., engineers.

BASIC BUILDING BLOCKS FROM KEARFOTT



Data Logging

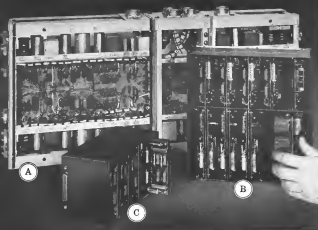
Kearfott's broad line of test equipment includes the Scanlog 200-Beam Alarm Logging System which monitors, logs and performs an alarm function of up to 200 separate temperatures, pressures, liquid level or flow transmitters. This precise data handling system is equipped with manual override for recording rate, automatic or manual logging, data input relating to operator, time, day, run number and type of run. 200 numbered lights correspond to specific points being monitored and provide a visual "off normal" display for operator's warning. System can be expanded to 2000 points capacity and 5000 points per second scanner rate.

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Above are three Stavid systems in development, showing Stavid advances in high density packaging. *Read: less cost/volume/weight.*

Unit A, a portion of a guidance system developed in 1955, was redesigned by Stavid in 1958 to adapt it to mechanical assembly techniques. Although no savings was made in manufacturing, Stavid achieved a 78% volume reduction and a 60% weight reduction—and added a regulated power supply. (Unit B) Unit C is the package, manufactured through the use of solid state components. As a result of years of experience in designing for more automatic and mechanical assembly, Stavid has developed an expertise capability—that of reducing volume, weight and production cost—and at the same time providing greater reliability, producibility and maintainability in all types of electronic equipment, including the most sophisticated systems.

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Dr. P. P. POLITOVICH, Stavid Project Engineer, has been active in the electronic and mechanical design of electronic systems utilizing mechanical assembly techniques. He is presently engaged in a program of mechanical assembly techniques research.

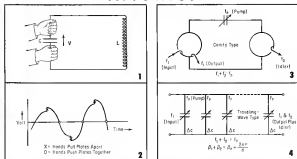


FIG. 1 illustrates principle of parametric amplification, used in new low-noise amplifiers, in terms of simple mechanical circuit in which loads pull together plates apart when voltage is applied. **Fig. 2** is an example of a parametric amplifier. Two types of parametric amplifiers are shown as variable capacitors in shown schematics in **Fig. 3-4**. **Fig. 3** shows the cavity type which is simpler, less expensive, but not as stable nor as wideband as the traveling wave type shown in **Fig. 4**. Cavity type requires less pumping power.

Parametric Amplifier Types Increasing

By Dr. Glen Wade*

Improvements in the performance of solar, communication and radar receiver systems which were unobtainable only a few short years ago have become possible through the use of parametric amplifiers, a new class of device based on a principle first conceived nearly 100 years ago.

The principal advantage of these parametric amplifiers is that even when operated at room temperature, they can be made to generate very little noise. Consequently, parametric amplifiers can detect extremely weak signals—signals that can be detected by other microwave amplifiers at room temperature.

Noise Performance

The parametric amplifier, for many applications, has a noise performance that is superior to that of the bulk and noise amplifier even though the latter has been worked on continuously over a longer period of time and is in a more advanced state of development.

For example, the lowest measured noise temperature at present for a bulk and noise amplifier operating at 5,000

mc is about 270 deg. Kelvin, while that of an uncooled parametric amplifier operating at the same frequency is about 70K. For a refrigerated parametric amplifier, the noise figure is even lower. This means that if used in antennas aimed at the cold sky, the parametric amplifier could detect a signal with less than half the power level of the smallest signal that could be de-

tected by the backward-wave amplifier. However, a simple comparison of relative noise temperatures does not tell the whole story and can be quite misleading in comparing parametric with other types of amplifiers, depending upon the applications. For example, because the parametric amplifier is a signal-to-noise device, and because it generates as another signal, known as

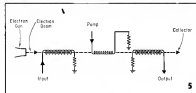
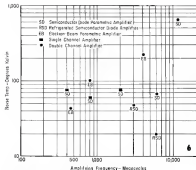


FIG. 2 illustrates electron beam parametric amplifier which has similar characteristics to traveling wave diode amplifier, but uses hot wires as an electron beam. Pump produces field which transfers energy to electrons by amplifying their wave motion. Input couples waves to introduce signal signal and to remove noise from the first wave.



REPRESENTATIVE noise power spectral densities for semiconductor and electron beam parametric amplifiers as a function of operating frequency and type of operation.

the after signal, its noise behavior is markedly different from that of a back-soundwave amplifier.

In a number of applications the after signal is a reference and must be kept from interfering with the signal to be amplified by filtering out the after frequencies from both the amplifier input and output. When filtering is used, this is referred to as a single channel operation; when filtering is not employed, it is called double-channel operation. The measured noise temperature under single-channel operation is often significantly higher than that under double-channel operation. (The noise temperature comparison between parametric and backward-wave amplifiers

is discussed previously in a paper on double channel operations.)

The term "parametric" comes from the fact that a variable parameter is involved. The mathematical equation describing the phenomenon will have a parameter which is periodic—just as, one of the terms has a coefficient that varies with time, occasionally referred to as the parametric term.

Tuning Fork

In 1860, H. Melde described and analyzed a system in which oscillations of a string were produced parametrically by excitation from a tuning fork. Several decades later, Lord Rayleigh applied the principle to a simple LC (re-

ductive-capacitive) circuit pointing out that oscillation in the circuit could be parametrically excited if the value of the capacitor were made to vary periodically at twice the resonant frequency of the circuit.

To illustrate this principle, assume that a pair of hands (not described by Rayleigh) are applied to the capacitor so as to be able to push the capacitor plates together and pull them apart at will, thereby varying the circuit capacitance as shown in Fig. 1.

Further assume that prior to any movement of the hands there is some energy stored in the circuit which is oscillating back and forth between the capacitor and inductor at the circuit's resonant frequency. If the hands suddenly pull the capacitor plates apart at the instant when the voltage across the capacitor reaches a maximum, this will reduce the capacitance and produce a corresponding increase in the voltage across the capacitor, as shown in Fig. 2.

A quarter cycle later, when the voltage goes to zero, the hands quickly push the capacitor plates back to their original position. Since there is no change on the capacitor at the instant there will be no change in its capacitance hence no change in voltage.

Still another quarter of a cycle later when the voltage again reaches a maximum, if the hands again quickly pull the capacitor plates apart, the voltage across the capacitor will again increase.

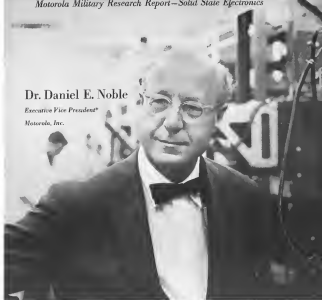
This increase in voltage across the capacitor, or voltage amplification, produced by the movement of the capacitor plates results from the flow of energy from the hands which are pumping the plates up and down.

In a parametric amplifier, the energy source used to perform the function of the hands in the former illustration is called the "pump." Normally this is a source of radio frequency power. Because of the parametric principle, a beat phenomenon takes place and a

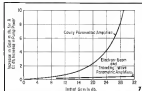
Dr. Daniel E. Noble

Executive Vice President*

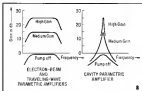
Motorola, Inc.



*DR. NOBLE IS VICE PRESIDENT OF MOTOROLA, INC. HE IS RESPONSIBLE FOR THE SOLID STATE ELECTRONICS DIVISION, THE SEMICONDUCTOR DIVISION, DESIGN AND THE MILITARY ELECTRONICS DIVISION OF MOTOROLA, INC.



RELATIVE INSTABILITY of cavity type parametric amplifier gain with variation in pump power is shown at left in comparison of increase in gain from initial gain for a 0 dB increase in parametric amplifier pump power level. Drawing at right shows low bandwidth of electron beam and traveling-wave type parametric amplifiers causes constant noise wide frequency regardless of amplifier gain (left side), but bandwidth of cavity type gain drops sharply with higher gain (right side).



"In this new era, Solid State Electronics will spread its influence to every form of human endeavor and will contribute substantially to scientific achievement in all fields."

Dan Noble



John C. Gachert, right, manager of the Microwave Applications Laboratory, and a member of his staff inspect a parametric amplifier, one of several devices now being produced by Motorola's Solid State Dept.



Ferrimagnetic principles are demonstrated by scientist in charge of Motorola's Solid State program, Dr. H. William Wicks, Jr., director of research and development, Military Electronics Division. Dr. Wicks as a University of Michigan professor established that school's Solid State laboratory and introduced new curricula in Solid State devices and their applications. He holds an I.R.E. Fellow Award for contributions in development of solid state devices and microwave tubes.



Typical of solid state materials now being offered for sale by Motorola are these ferrite rods and bars being processed by Donald L. Frank, manager of the Solid State Materials Laboratory.

Imaginative leadership plus the most modern of laboratory facilities have helped foster a creative environment that is attracting top talent to Motorola. Now, Dr. Arthur L. Ades, associate director of research and development for Motorola's Military Electronics Division, shows a new member of his staff equipment for photographing printed circuits. Dr. Ades welcomes inquiries from qualified engineers and physicists who would like to join his department.



James R. Black, manager of Motorola's Microelectronics Laboratory, heads work which leads toward the mass production of economical microelectronic components so small that several would fit on the

How Solid State Electronics is shaping the future

MILITARY ELECTRONICS—industry as well—is being radically changed by rapid advances in solid state technology. Predicted for the near future are computers small enough to fit in the palm of a hand, receivers that will detect the weakest signals from distant satellites.

Motorola's highly experienced Solid State Department, in close cooperation with the Semiconductor Products Division, is advancing the state of the art on several fronts, one of the most promising of which is microelectronics.

By making use of crystalline functional circuit elements created in volume quantities by surface etching or film deposition methods, Motorola researchers anticipate they will soon be able to design equipment with component densities of tens of millions per cubic foot.

This high density will result in a great reduction in systems and computer size coupled with a significant increase in reliability, and it will lead to the development of self-organizing computers for such complex tasks as the solution of military logistics problems and space guidance.

In microelectronics and in other areas, Motorola scientists, including those of the Semiconductor Division, are investigating the ferroelectric, ferrimagnetic, piezoelectric and pyroelectric characteristics of monocry-

stalline and polycrystalline solids. New materials possessing these useful characteristics are created and produced in the Materials Laboratory. Typical applications: newly developed ferroelectric or piezoelectric materials to be used in transducers for submarine detection.

At present, the Applications Laboratory is making extensive use of ferrites and semiconductors in the development of broad lines of isolators, circulators and parametric amplifiers. The latter device has already demonstrated its worth in satellite-tracking radars, IGY research receivers, air television receivers and radio. In the study and design stage are new and advanced ferrimagnetic devices such as microwave switches, ferrimagnetic limiters and semiconductor switches.

Still another research frontier where striking preliminary results have been achieved is a low-voltage feasible paper for the transmission of teletype and other information. Applications in the fields of combat surveillance, logistics control and other important military programs are foreseen.

Military Electronics Division's expanding capability in solid state electronics is described in a new booklet entitled "Solid State Frontiers at Motorola." Request your copy from Technical Data Service, Motorola, Inc., Military Electronics Division, 8201 East McDowell Road, Scottsdale, Arizona.



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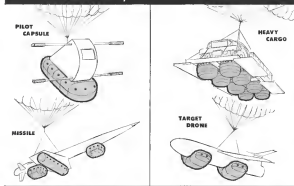
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third signal is generated whose frequency is equal to the difference between the pump frequency and the amplifying frequency. In the conventional parametric amplifier, where the input and output signals have the same frequency, the third signal is an unused byproduct and hence is called the idler frequency.

For regenerative amplification, the pump frequency must be higher than either the amplifying or idler frequencies. In applications where magnetic channel operation is required, it is important that the pump frequency be as high as possible to minimize amplifier noise.

For single-channel operation at room temperature, the minimum theoretical noise figure is equal to five times of the pump frequency to the idler frequency.

For double-channel operation, or for operation where the noise sources are below room temperature, the minimum theoretical noise figure is not restricted by this frequency ratio.

These different types of parametric amplifiers have been built to date, using semiconductor diodes, ferrites and electron beams. Although the ferrite amplifiers have apparently proved to have certain advantages over the diode and electron-beam types, it is considerably less far advanced than the former and there are too many unknowns to be able to predict its future value. For this reason, the discussion that follows will consider only the semiconductor and electron beam types of parametric amplifiers.

One of the disadvantages of a semiconductor diode is the fact that its capacitance varies as a function of the voltage impressed across its junction. If a variable source of voltage is connected across a P-N junction diode so that the positive terminal is attached to the N-type material and the negative terminal to the P-type material, the electrons in the N-type material and the holes in the P-type material are repelled, producing a thin depletion layer near the region of the junction.

If the applied voltage is increased, the depletion layer expands. If the polarity of the applied voltage is reversed and the voltage is increased, the depletion layer contracts. Thus the depletion layer resembles the space between the plates of the capacitor in the previous discussion.

As the depletion layer widens, the diode capacitance decreases. When the depletion layer contracts, the capacitance increases. If the voltage applied across the semiconductor diode oscillates at microwave frequencies, the capacitance of the diode will vary also at microwave frequencies. This provides the necessary pumping action for microwave parametric excitation and

therefore for microwave amplification. There are two fundamental classes of parametric amplifiers which are diode, varactor and ferrite-core types.

• **Diode type amplifiers** operate can be represented by two resonant circuits, coupled in series with a variable inductance, as illustrated in Fig. 3. (Diagrams are simplified and does not show pump voltage impressed across diode to produce variable capacitance.) The pump voltage impressed across diode the two circuit resonant frequencies as f_1 and f_2 .

An input signal at f_1 is fed into the circuit at the left, which is resonant to that frequency, and an amplified version of the signal is extracted from output of the same circuit. An idler signal at f_2 is generated in the second circuit and can be extracted from it if desired.

For single-channel operation, the idler signal is not extracted and if f_2 and f_1 are sufficiently different, the first circuit provides the filtering needed for both the input and output. Often in the case of double-channel operation, f_1 and f_2 are so nearly equal that one output circuit is needed and signals at both the amplifying and idler frequencies then appear simultaneously within the single circuit.

Under these conditions the input and output couplings will pass both the amplifying and idler frequencies directly.

Because of the parametric excitation, the variable capacitance and the idler circuit appear to couple a negative

conductance into the input circuit, at least. The gain therefore is expressed by the equation for regenerative amplification and its maximum can be written as follows:

$$\text{Power gain} = \frac{R_1}{R_2 - G_2}$$

Where:

R_1 is a constant which depends upon input and output loading and has the dimensions of conductance squared.

G_2 is the summation of all the positive conductances loading input circuit.

G is the magnitude of the negative conductance which is coupled into the input circuit. This is proportional to the square of the total variation in capacitance. In a semiconductor diode, capacitance variation is approximately proportional to the square root of pump power. Hence G is approximately proportional to pump power.

• **Ferrite-core parametric amplifiers** consist of a transmission line which is periodically loaded with semiconductor diodes. Across each diode is fed a large pumping voltage which produces a transverse capacitance, as shown in Fig. 4. If the propagation constants of the amplifier are suitable chosen, so the sum of the constants for the input and idler frequencies equals that for the pump frequency plus the term $\frac{\pi}{n}$, where n is an integer including zero and $\frac{\pi}{n}$ is the distance between adjacent diodes, then the diodes appear to couple negative conductance into the transmission line at periodic intervals along the line. Under these con-



Avionics Tested on Agena Satellite

Agena satellite used in Advanced Research Projects Agency Discoverer program develops checkout and modification of avionics equipment at Lockheed Martin and Space Division, Palo Alto, Calif. Bell Helicopter rocket engine powers the Agena, which is the second stage of the Thor-Buster vehicle.



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continues the power gain is expressed by the following:

Power Gain = $G \times L$

Where "G" is proportional to the capacitance variation and therefore to the square root of pump power.

"L" is the length of the traveling wave section of the amplifier.

The nature of individual electrons in an electron beam can be pumped parametrically and made to grow. This is the principle upon which the electron-beam parametric amplifier operates.

This process can be understood by means of a mechanical analogy of a single electron in the beam, consisting of a pendulum bob moving in simple harmonic motion. Assume that the pendulum bob is charged positively and that it swings across a uniform electric field whose magnitude can be varied at will.

If the field is uniformly turned on whenever the pendulum reaches either end of its travel and is suddenly turned off when the pendulum swings through the center equilibrium position, the motion of the pendulum will be increased or amplified by the pumping action of the electric field.

Oscillating Electron

When an electron in a beam is released from its equilibrium position, it will oscillate around that position in such a way that its component of motion in any plane containing the beam can be simple harmonic motion. This is true for both transverse waves of electric waves, such as cyclotron waves, and longitudinal waves, such as space charge waves.

In this sense, the electron is analogous to the pendulum bob and since the electron carries a charge it is analogous to the charged pendulum described. Specifically a suitable time-varying electric field is also capable of pumping or amplifying the motion of the electron. Since the equilibrium position of the electron track with the beam, the pumping field must also, in effect, travel with the beam. A traveling electric field of the proper kind can parametrically amplify the wave motion, be either transverse or longitudinal waves, of all the individual electrons in a beam.

This type of parametric amplification is possible for both the so-called fast beam waves and the slow beam waves, a fact of great importance in achieving low-loss amplification. Many conventional microwave tubes, such as the traveling wave tube and klystron, amplify by virtue of interaction of the field with a slow beam wave.

It has been established theoretically that when the beam energy from the electron gun, the wave present in the slow wave cannot be completely removed or canceled whereas complete



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POWER 110 vac. 40-60 cps or 24 vac.
FLUTTER: Less than 0.1% over dc to 500 cps or 1% peak-to-peak at 30 cps
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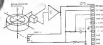
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Operational diagram of Donner's new Model 4525 Angular Accelerometer

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RANGES AVAILABLE
From ± 1 rad/sec² to ± 50 rad/sec² to any intermediate range
FREQUENCY RESPONSES
 ≥ 1 rad/sec² 50 cps natural frequency (40% lag)
 ≥ 10 rad/sec² 100 cps natural frequency (40% lag)
OUTPUT, FULL SCALE
 ≥ 25 volts across a 12,500 ohm load
RESOLUTION 0.01% full scale or better
LINEARITY 0.1% full scale
HYSTERESIS Less than 0.01% full scale
DAMPING 0.6 to 0.1 of critical
SIZE 3 7/8" diameter x 3 7/8" high
WEIGHT 2 pounds

Donner's rugged new angular accelerometer weighs only 2 pounds.



Mockups Facilitate Computer Production

Mockups of computer components are used by Litton, Inc., a subsidiary of General Precision Equipment Corp., to facilitate development of efficient production methods. Mockups are easily constructed of wood to follow in exact detail the dimensions and configurations of equipment which must be fitted to conform to specified cabinet dimensions and configurations. Worker is preparing cable harness on a mockup board which contains wooden subassemblies and terminal blocks in proper relationship to final equipment wire locations. Detailed wooden subassemblies are on bench in foreground.

noise manual is theoretically possible for the first time.

There already is experimental confirmation that the effective beam temperature of a fast electron wave can be reduced to below 25K.

Basic configuration of an electron beam parametric amplifier is shown in Fig. 5. The three sections of helix represent the input coupler, amplifying section, where pump power is coupled into the beam, and the output coupler. The input coupler serves two functions: to couple out of the beam the entering intrinsic components of beam noise, thus cooling the beam, and simultaneously to modulate the beam with a new fast wave corresponding to the input signal.

This type tube has come in common with the traveling-wave diode amplifier than with the cavity type diode amplifier. For example, both the traveling-wave diode amplifier and electron beam parametric amplifier can be relatively wide band and the relationship between gain and pump power is the same for both.

(For details on electron-beam parametric amplifier developed by Zenith see *Aviation Week*, Sept. 1, 1958, p. 66. For details on Bell Telephone Laboratories diode amplifiers, see *Aviation Week*, Aug. 4, 1958, p. 69.)

The general characteristic most sought in parametric amplifiers has been low-noise performance. A graphic presentation of current noise temperature achieved to date for both diode and electron-beam parametric amplifiers is shown in Fig. 6.

However, there are other factors to be considered, depending upon the end application. For example, the cavity type diode amplifier is more rugged and less expensive than the traveling-wave type or electron-beam parametric amplifier.

Another advantage of the cavity type is that it requires relatively little pump power.

The main disadvantage of the cavity type diode parametric amplifier appears to be its inherent instability. If pump power changes even slightly the amplifier's gain can change drastically.

This is illustrated in Fig. 7 which is based on calculated theoretical performance.

For example, if the amplifier has an initial gain of 25 db and pump power changes by only 0.1 db, the cavity type parametric amplifier will experience a 5 db increase in gain compared with less than 0.5 db for either a traveling-wave diode type or electron beam parametric amplifier.

The cavity type is by nature com-

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Washington—Futuristic radar with a 1,000 ft. diameter antenna will be constructed in Puerto Rico for the study of ionization effects of ballistic missile heat cone plume through the upper atmosphere during sub-orbital flight, for measurement of electron densities and temperatures in space and for radar mapping of the moon and nearby planets, according to the Advanced Research Projects Agency. Construction of the radar was predicted by Avionics Week last Nov. 24 (p. 25). The \$4.5 million facility will be constructed by Cornell University under Air Force contract. Next summer will consist of parabolic shaped hole scooped in the ground, covered with wire mesh. Radar will operate at 400 mc.

plectic, reciprocal and for best performance requires the use of a circulator. The traveling-wave type can be designed to be non-reciprocal. In flight, it should be capable of short-circuit stability but because of reflections within the transmission line, this is difficult to achieve in practice.

The electron-beam type is by nature non-reciprocal because a signal applied to the output terminal can not be carried upstream by the beam to appear at the input terminal. In a sense the circulator provides its own built-in circulator and consequently it shows short-circuit stability.

Bandwidth

Cavity type amplifiers are inherently narrow band but special techniques can be used to increase the bandwidth. Preliminary experiments at Bell Telephone Laboratories indicate that a 40% bandwidth at 500 mc is possible in a post-circuit amplifier. When these techniques are not used, the bandwidth of the cavity type amplifier is a function of gain, as shown in Fig. 3.

Theory indicates that the bandwidth of traveling-wave type and electron-beam type parametric amplifiers should not be a function of gain, but practice does not bear out theory in the case of the traveling-wave type. Bandwidths of 40 mc. have been achieved by Zenith in its electron-beam amplifier operating at UHF frequencies. Analysis indicates this figure can be tripled at center frequencies below 1,100 mc., with bandwidth of 10% possible at higher frequencies.

Travel at upper frequency limit is concerned, diode type parametric amplifiers have been operated at 10,000 mc. (X-band) with good low-noise performance at this frequency. The electron-beam amplifier has been operated at frequencies as high as 4,000 mc., and Zenith reports it is planning a de-

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view for X-band operation. However, the problems of fabricating in electron-beam processing applicable to this small diameter required for extremely high frequencies suggests that the practical upper limit may be around 10,000 mc.

Expansions, Changes In Avionics Industry

Convair Division of General Dynamics Corp. has set up new electronics department at its San Diego Division "to facilitate further entry expansion in this field." R. E. Hoyer, senior assistant chief engineer for electronics, has been named manager of new department. Other appointments include W. E. E. Bever, program management; F. C. O'Neil, engineering; E. W. Carlson, manufacturing; W. R. Rauh, customer requirements; W. S. Stroud, administration. Department currently has 710 employees, 500,000 sq. ft. of space in Convair's Plant 1.

Other newly announced changes, expansion and appointments in the avionics field include:

• **International Electronics Corp.** (INTEC), March, N. Y., will acquire Western Electronics, Inc., Westfield, N. Y., maker of radio and magnetic products. Combined organization will have gross sales of about \$3 million in 1968. Hovav Abagyan, president of new acquisition, becomes a vice president of INTEC.

• **Edsonco, Inc.**, subsidiary of General Precision Equipment Corp., has established new applied research department to investigate new concepts in solid state physics. Warren Blackburn has been named director.

• **Telecomputing Corp.**, Los Angeles, has formed new Electronic Systems Division through integration of its Radio Electronics and Nuclear Instruments Divisions. Boris N. Fisher, former general manager of Intelsat, heads new division.

• **Haseltine Research Corp.**, a subsidiary of Haseltine Corp., is opening new research and development center in Flushing, N. Y. (George B. Davis has been named president and Dr. R. K. Hoffman, vice president of parent company, is operating vice president and technical director of new operation).

• **Antennas Division** of North American Aviation has established four separate products divisions: Antennas and Flight Controls, under C. A. Wolf, Computers and Data Systems, under N. F. Fisher; Inertial Navigation, under S. F. Erickson, and Industrial Products, under E. A. Holmes, III, as operations manager. Each operations manager is



Inertial Reference Unit Developed for Vega

Inertial reference unit of Vega rocket vehicle's guidance system compares stable platform (center, above), made of which are three accelerometers and three gyroscopes. Customer models of accelerometers and gyroscope are at left and right, above. One such model below shows configuration of 6,000-lb. thrust shakable liquid propellant engine system which will be used in last stage of Vega. Large tanks are for oxidant and fuel. California Institute of Technology's Jet Propulsion Laboratory is developing Vega system for National Aeronautics and Space Administration.



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contributed by P. Caloz, G. Duflo, G. Gifford and P. Pallat.

► **Wideband Super-Power Klystron**—A broad-band klystron, with bandwidth of approximately 15% and power output in the megawatt range, has been developed by Varian Associates. Development was reported by W. Brown, G. Cavallini, G. Haffner and N. Taylor.

► **Selective-Emission Storage Tube**—New electronic hollow storage tube, which permits rapid erasure of one or more of the smallest surface elements without erasing entire display as in previous storage tubes, was reported by N. H. Lohrke, of Hughes Research Laboratories, Culver City, Calif. New tube also permits nondestructive writing, i.e. the preservation of information on the tube face without disturbing writing on erased area of the storage target. Tube employs special charge target which exhibits dual charging phenomena. Depending upon the incident beam energy, the storage surface can be positively charged by secondary emission or it can be charged negatively by bombardment-induced conductivity. At lower beam energies, the secondary emission effect predominates, while at higher energies the induced conductivity predominates, Lohrke reported.

► **Microwave Transistor-Coupled P-N-P**—New transistor with diode base and alloyed contacts developed by Bell Telephone Laboratories can be operated at 3,000 mc. as an oscillator or amplifier, or can be used in feedback amplifiers requiring bandwidths of 500 mc., according to a report by R. E. Davis, C. A. Bettemann, R. J. Gaudin.

► **New Diode for Parametric Amplifiers**—Silver-bonded diode, which is superior to gold-bonded diodes for use in parametric amplifiers, was described in a report by three Japanese scientists, S. Kita, K. Sugawara and T. Hagiwara, of the Nippon Telegraph and Telephone Public Corp., Tokyo. Scientists reported that new silver-bonded diodes have been used to construct a parametric amplifier for operation at 6,000 mc. which exhibits bandwidths of 40 mc. gain of 20 db and a noise figure of about 5 db.

► **Hypersonic Silicon Capacitor**—Hypersonic voltage-variable silicon capacitor having a range of 10:1 variation in capacitance for a 10:1 change in voltage was described by H. D. Foster, of Pacific Semiconductor, Inc., Culver City, Calif. New units have Q-factor greater than 76 at frequency of 50 mc. and a maximum capacitance of 20 pfd to 1,000 pfd.

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RENE 41*

Typical Mechanical Properties

TENSILE PROPERTIES

| Spec. Temp. | 1400°F |
|-------------------------|---------|
| Ultimate Strength, psi | 800,000 |
| 2% Yield Strength, psi | 110,000 |
| 10% Yield Strength, psi | 135,000 |
| Elongation (% in 2") | 15 |
| Reduction in Area, % | 18 |

STRESS RUPTURE

| Temperature, °F | 1400 |
|----------------------|---------|
| Stress, psi | \$1,000 |
| Life, Hours | 100 |
| Elongation, % | 15 |
| Reduction in Area, % | 14 |

| Combustion Strength and Proof for | 1400 |
|-----------------------------------|---------|
| Stress, psi | \$1,000 |
| Life, Hours | 100 |
| Elongation, % | 15 |
| Reduction in Area, % | 14 |

Guaranteed Minimum Mechanical Properties

TENSILE PROPERTIES

| Spec. Temp. | 1400°F |
|-------------------------|---------|
| Ultimate Strength, psi | 180,000 |
| 2% Yield Strength, psi | 115,000 |
| 10% Yield Strength, psi | 135,000 |
| Elongation (% in 2") | 15 |
| Reduction in Area, % | 14 |

STRESS RUPTURE

| Temperature, °F | 1400 |
|----------------------|---------|
| Stress, psi | \$1,000 |
| Life, Hours | 100 |
| Elongation, % | 15 |
| Reduction in Area, % | 14 |

| Combustion Strength and Proof for | 1400 |
|-----------------------------------|---------|
| Stress, psi | \$1,000 |
| Life, Hours | 100 |
| Elongation, % | 15 |
| Reduction in Area, % | 14 |

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MANAGEMENT

Job Survey Cites Administration Apathy

Every few months, trade and technical magazines on about an engineer's/scientist shortage that doesn't exist. Three years ago we conducted a comprehensive, nation-wide survey of engineering recruitment practices. Results, published by *Aviation Week* Jan. 21, 1977 (p. 9), proved the shortage was in personnel practices, not in available engineers.

Management displayed marked interest in that survey. Many companies (the best being Lockheed) expressed a desire to improve their own personnel administration. A survey taken recently, however, proves that no significant changes have been made. If anything, the situation is worse than it was, particularly with aerospace to senior engineers.

To evaluate job recruitment clerical assistance, 226 engineers presently in the aerospace industry, gave us their job-hunting results for and reasons for unsatisfactory performance. Eighty-nine resumes were sent to companies all over the U.S., applications were filed; interviews were arranged; new positions were accepted. Consider:

• Of every 10 resumes submitted, two were ignored.

• Of every 10 applications submitted, two were ignored.

• Of every 10 applications submitted, two were ignored, two checked, turned down before despite the fact that the information was exactly the same as that in the resume. Fourteen longer firm line works to reply, and two resulted in personal interviews.

• Of the personal interviews, one of every two took in excess of six weeks to follow a verbal offer with a written offer.

• Of the 226 engineers and scientists who answered our questionnaire, 35 gave their own opinion for the initial interview because it took the prospective employee too long to make the transition to-travel.

Twenty-three respondents did not accept the position they interviewed, the one that would have made full and complete use of their capabilities, because the companies took too long to make a final offer. Examples cited below are based on all 23.

• **Henson Engineer** was in years' experience in space research was interviewed and verbally accepted by D Company. He resigned his position in anticipation of the forthcoming offer. One month and four phone calls later, the formal offer had not arrived. Was

the delay caused by reference check? Classroom? Work history? No. The personnel administration could not agree on a salary. Henson Engineer applied elsewhere, took a lesser, less fulfilling job because he could not afford to wait indefinitely for D Company to reach a salary decision.

• **Mink Engineer** was verbally accepted during personal interview Oct. 1. "We need you desperately and immediately," was said. His reporting date of Nov. 1 was offered; the company, even though it was considered "too distant." He returned to his home to wait for the formal offer. It had not arrived by Nov. 1 despite the fact that he was still needed "desperately and immediately." What was the holdup? The personnel department had not allocated space. By the time space had been allocated, Mink Engineer had gone to work elsewhere.

• **Armstrong** was with 12 years' experience was placed by an "executive search" employment agency. Three representatives of one company interviewed him with the final word being, "We'll let you know your upcoming letter in a week." Six weeks later he received a telephone from a fourth representative of the same company asking him to come to another city for still another interview. He accepted another position.

There are no isolated cases. Companies spend in excess of \$8.7 million annually in recruitment advertising, pay millions more to bring engineers to the facility for personal interviews, only to have all efforts bog down in paperwork that should have been completed before the ads ever appeared in print.

Demotivated engineers and scientists are abandoned from one automobile job to another, their full abilities never used, the "right" job eludes them primarily because of poor personnel administration. When an experienced technical man answers an ad, he's looking for a job. If verbal job offers cannot be followed-up within 16 days in firm offer, prospective talent that the company has no right to advertise the job or interview the prospective employee.

Dr. Mer A. Page and Nikki Kase, who prepared this survey, was part of a research team at Los Angeles, Calif. Dr. Page was in command Hughes Aircraft Co., Systems Analysis Laboratory and Nikki Kase is a magazine editor.

In the published report of our original survey three years ago, the outstanding complaint was that personnel people were unable to read and interpret applications. Three years later, that complaint is louder than ever. For example:

• **Engineer applying for a position in aerospace systems analysis** gives no background "logistics." The answer: "You're not interested in us, we deal with 'logistics'." (Logistics is hard-core.)

• **Engineer applying for an administrative position**, turned down because "We were interested with R & D experience." Applicant had spent six years with Air Research and Development Command—no stated in both aerospace and applications.

• **Resume and application** show applicant holds a doctorate. Only one company in 10 read the resume or application carefully enough to address the applicant as "doctor."

Paperwork Delay

Within many organizations, departments are strictly in need of technical help. Companies advertise, interview, hire, but cannot put before the prospective employee joins the company. Nine times out of 10, the delay is caused by poor paperwork routine. Money, time and effort are wasted because of inability to interpret a resume. When personnel people do not know where is a company to send a resume, they manage to kill at least 14 days' time by insisting on a formal application blank which usually contains no information on the resume. (Many of the reviewing, over-detailed application blanks subjected to rejection simply because.)

Over the years a formidable wall of misunderstanding has grown between the technologically advanced and administrative personnel. Our 226 respondents considered treatment on the part of personnel departments to be part of the Great Locking Process, or a further manifestation of the rift between the technologically advanced and the technologically advanced. Our survey showed conclusively that engineers and scientists move from company to company not necessarily for more money, but for a chance to work in human and professional dignity.

Respondents are attracted, and finally engaged by technology, but action on the part of personnel people. Unnecessary delays tend them to other



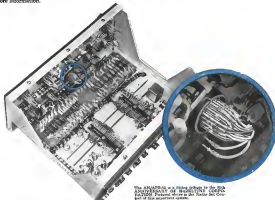
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company. Like workers in other fields, the technologically advanced feel a need-to-be-needed. It seems the unexpected use of administrative personnel to fill this need is the living process.

Letters of thanks are always timely. Although engineers do not pass around the letters, they do pass around the new issue. One company's "we super" letter, sent to a scientist with 14 years' experience, was signed by the College Placement Advisor. That one letter has cost the company at least 20 applicants.

Most companies (right out of 100 do not want personal papers, photostatic copies of college credits, or topics of published papers, nor do they reply to letters asking for the return of these papers. Although most letters of thanks do not use the phrase, "we will keep your letter as our action file" later square produces a blank.

The split between personnel people and the engineers is growing larger and thicker. Show the engineer or scientist that he is needed, valued, important and he'll work longer hours for less money. Constant letting him know he's merely a body, just one-obtain, and costs increase in salary, retirement expense and replacement. The time has come for a conceptual.

Temco Receives More Corvus Commitments

Delia, Tex.—"Significant" follow-on commitments to the Corvus air-to-surface "standoff" weapon system for Navy are now being made formal, according to Temco Aircraft Corp. President Robert McClellan.

This was one of the encouraging items reported during revelation of the company's sales for the first nine months of this year, which totaled \$77,715,740 providing net revenue of \$54,440, equal to 51 cents on the common stock outstanding. Sales for the comparable period last year were \$49,735,771 and earnings were \$1,520,600 or \$1.07 per share.

Decrease in profits was tied to costs of setting up production facilities at the company's subsidiary, Fossil: Tednek & Miller, Inc., which is completing the long-range multi-channel air and surface traffic plotting system and successful development of this toward research and development program.

He reported that orders received by Temco are up 26.6% and he believes the company is "at the bottom" of a declining cycle of business.

Backlog at first seven letters of intent and contracts under negotiation amounted to \$100,000,000 as of Sept. 30, compared with \$415 million a year ago.

PROGRESS REPORT



Miniature Electric Power Supply

THE NEED—Advanced missile weapons systems require a secondary power source to supply precise electrical power for such functions as fusing, target-seeking, and guidance. Power supply reliability, and package weight and size are critical. Environmental conditions are extreme.

THE OBJECTIVE—Because of their proved reliability, turbogenerators offer an optimum solution to the problem of precise power outputs over a wide range of ambient temperatures. The objective of an intensive Tapco-sponsored design and development program was to miniaturize turbogenerators to meet weight and envelope requirements.

TAPCO'S CONCEPT—With the benefit of many years of experience with turbines, alternators and controls, Tapco engineers have designed and developed Minitors—a solid-fuel miniature turbogenerator with multiple output capacities.

Minitors is a compact and light-weight, self-contained and self-regulated secondary power system. It includes a high-speed turbine and a compound electrical generator on a single shaft, and an interchangeable, plug-in type semiconductor speed control. A gas pre-mixer utilizing a solid propellant completes the miniaturized package.

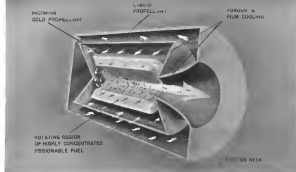
One of the significant features of the Minitors is the capacity to produce up to four different outputs of AC and DC, with AC frequencies precisely controlled. One version produces 50 watts of power for 90 seconds duration, yet weighs only 3 1/2 pounds and is less than eight inches long. Other versions produce up to 200 watts. Duration of outputs can be varied by increasing or decreasing the size of propellant grain.

Minitors was developed at Tapco within a 4-month schedule, and preliminary evaluation testing has been accomplished with success. The unit functions reliably in the temperature range of -65° to +100° ambient, delivering required outputs for the desired periods of time.

We would welcome an opportunity to tell you more about Minitors, and to discuss with you the application of Tapco-developed miniature secondary power systems in your current and future programs.



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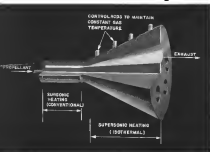


HYDRODYNAMIC containment of the gaseous fuel in a gaseous core nuclear reactor is shown in the sketch's caption above. Reactors of this type can theoretically operate at temperatures several times higher than the solid fuel nuclear reactors which require a heat exchanger made of solid materials. In the gaseous reactor

shown, the light propellant is heated by diffusing through the heavy fissionable fuel which is kept away from the center by centrifugal action. Studies to determine the probability of gaseous core reactors using hydrodynamic containment of the fuel are being conducted by Princeton University, the AEC and the NASA.

Advanced Nuclear Space Units Probed

By J. S. Bots, Jr.

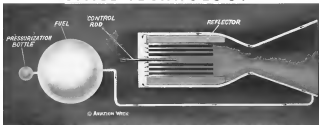


SOLID FUEL nuclear reactor in which the fuel is a part of the reactor is being studied to increase specific impulse. Theoretically, a large quantity of energy can be added to an exhaust flow using this type of constant temperature reactor. But much remains to be done as believed possible. This prediction depends on efficient superheating heat transfer from the inside wall to a desorbing propellant. Tests to determine if this is practical are planned.

Washington—Detailed study of possible configurations for nuclear rocket space propulsion systems is now, as pending, will increase the Kriev type solid-fuel reactor, high-pressure experimental engine under study in the Atomic Energy Commission at Oak Ridge, Tenn. (AEC Feb 16, p. 49).

Advanced studies are in progress at a number of educational institutions, the AEC and the National Aeronautics and Space Administration. Variety of the work being undertaken by educational institutions are indicated by the projects under consideration in Jerry Chou, Princeton University professor of Aeronautical Engineering. They include:

- **Gaseous fuel nuclear reactors** that require hydrodynamic containment of the fissionable material. A specific impulse of over 2,000 sec. at a vehicle thrust-to-weight ratio of 1.0 appears possible with gaseous fuel reactors because the transfer of reaction heat is not limited to the allowable operating temperature of a solid material heat exchanger.
- **Kriev-type solid fuel nuclear reactors** that have a chamber pressure of less than 1 psi. Almost complete destruction of the propellant is a possibility under these low pressures so that the



LOWERING chamber pressure is one of the ideas being investigated to increase the specific impulse of a Kriev-type solid-fuel nuclear reactor. Normally, the chamber pressure in this type of reactor could be several hundred psi, but dropping it to 0.2 psi would cause almost complete destruction of liquid hydrogen propellant. Even the case of its release particles up to 49% and, therefore, raise its specific impulse the same amount. Schematic (above) of a low-pressure nuclear reactor illustrates the fact that it would not need a pressurization pump in turbine. (Usually needs could be met by solution, electrolysis or argon gas or the cooling gas.)

specific impulse, using liquid hydrogen could be increased by almost 40%.

- **Large solid-fuel nuclear reactors** in which the fuel is a part of the reactor. This arrangement provides an approximation of an isothermal reactor and allows energy to be added to the propellant flow over the entire length of the engine.

Advanced studies are in progress at a number of educational institutions, the Atomic Energy Commission and the National Aeronautics and Space Agency.

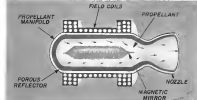
A gaseous core nuclear reactor using hydrodynamic containment of the fissionable fuel was studied by Dr. Gory as an alternative to electrodynamic containment with its requirement for heavy coils and power generating systems. Hydrodynamic containment is possible because the mass of the fissionable atoms is much higher than that of the propellant.

If a mixture of fissionable fuel elements and propellant is injected tangentially and at high velocity into a cylindrical combustion chamber, a combination of gaseous fuel bubbles against the wall. The propellant will diffuse through the fuel to the center of the chamber and stream out of the nozzle.

As the fuel mass builds up, it will become critical and begin to heat the propellant which also acts as a moderator for the fusion reaction. The temperature of this reaction could be several times higher than the 6,000°F now considered to be an absolute maximum for solid fuel reaction. Blowing of the

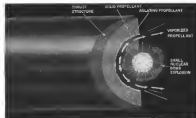
wall by conduction from the hot gases will be negligible because of the heat cooling provided by the cold incoming propellant. Minimum temperatures in the reactor would be determined by the large thermal radiation of the reacting gases.

It is conceivable certain that the hydrodynamic containment scheme would help moderate use of the gas objects made in the past against the use of a gaseous core reactor—that containing fissionable material out of the reactor at a rapid rate where a uniform mixture of fuel and propellant was considered would create an unacceptable hazard.



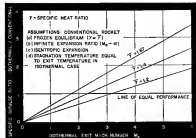
MAGNETIC containment for the fuel in a gaseous core nuclear reactor is the best alternative to hydrodynamic containment. At the high operating temperatures of these reactors, the fuel would be completely ionized and could be applied to the center of the chamber by a "magnetic mirror" arrangement. It is possible that operating difficulties with these two basic containment ideas would require that they be combined. A combination system has some advantages to solid fuel so that it would collect more work by constant action.

the needs of such a rocket. Feasible amounts would have to be injected at a definite rate into the propellant to start the rocket and, as critical mass was reached, the flow reduced to just propellant.



Rocket Powered by Nuclear Bombs

Author's conception of rocket powered by the explosion from a series of small nuclear bombs is shown above. This general concept is being investigated under the Atomic Energy Commission's Project Orion. General Atomics Division of General Dynamics Corp. has the principal industry contract under this project. Past objections to this type of rocket have been the great structural weight needed to resist the explosive, low average thrust-to-weight ratio and low average specific impulse. Current confusion is shown in the below material. In the sketch above the solid propellant in the conventional form of the rocket might be replaced by the injection of a liquid fuel which would cover the same purpose of increasing the weight of the exhaust during each bomb explosion.



Isothermal Nozzle Increases Rocket Power

Theoretical increase in rocket performance that can be obtained with the use of the isothermal nozzle is shown above. Present opinion is that an exit Mach number of 5 can be obtained. If this is true, the use of a propellant that is decomposing hydrolysis with a rate of specific heat ratio near 1.67 would make possible a three-fold improvement in the specific impulse of nuclear rockets.

Accurate control of the rocket's power by varying the temperature of this fuel mass is now a matter of some considerable doubt.

Critical Separation

Critical fuel separation and control experiments are now in progress in several U.S. laboratories. The results of this work sponsored by the Atomic Energy Commission and the National Aeronautics and Space Administration will be a major factor in determining the feasibility of hydrodynamic containment of a gaseous core reactor.

Another lack of experimental data which has forced broad assumptions and possibly serious errors in the theoretical studies of this engine, is in connection with the thermal conductivity of comparatively dense high-temperature gases. Until this is known it will not be possible to determine just what the heat transfer to the combustion chamber walls will be and how high the allowable operating temperature can go. Knowledge of some high-temperature plasma is growing rapidly with contributions being made by laboratories in a number of countries.

Engine Description

Engineering problems connected with a gaseous core rocket would be formidable.

They are illustrated by a description of the engine within the limits of present knowledge:

- Diameter of combustion chamber, 5 to 50 ft. in diameter.
- Minimum chamber throat, .5 million to 10 million ft.
- Minimum chamber inlet pressure, 100 to 1,000 atmospheres.
- Minimum initial temperature of propellant, 30,000 to 100,000 deg. Rankine.
- Propellant injection would have to occur through numerous small orifices, making combustion chamber with essentially porous.

Alternative

An alternative to pure hydrodynamic or electrostatic containment which may prove attractive is a combination of the two. In this arrangement, the ionized fuel would be sealed by rotating magnetic fields, but separation and containment would depend upon centrifugal action rather than by separating the fuel plasma. The disadvantages of the large combustion chamber would be present, but it would be one way of circumventing the requirement for very high pressure drops in the chamber wall. Other configurations might prove necessary as design information becomes more complete.

The fact that low pressures and high temperatures tend to promote the dissociation of gases has opened a new area



of study which would not be of interest for chemical-fueled rockets but may prove useful for nuclear rockets.

Splitting the molecular bonds of the propellant gases during dissociation "breaks up" a large quantity of energy which could be used to increase the exhaust velocity and performance of a rocket. That sufficient energy and exhaust velocity cannot be obtained in a chemical rocket. The finite limitation of available energy in chemical rockets requires that dissociation at the nozzle exit be kept to a minimum. If the most efficient energy expenditure is to be maintained, dissociation losses in the combustion chamber and nozzle throat must be counteracted by atomization and energy release during the temperature drop and expansion of the flow in the nozzle.

Efficiency Losses

The atomization is achieved in the case of the nuclear rocket with its essentially unlimited energy. Efficiency losses can be accepted. It would be of no concern that a large amount of energy was lost in completely dissociated exhaust flow if an increase in exhaust velocity could be achieved. Provided that allowable nuclear power density is not exceeded. In fact, dissociation would help in this case because it would lower the mass of the exhaust particles and raise the specific impulse even more.

Studies at Princeton are directed toward obtaining experimental proof that dissociating propellants can be used in practical engines to achieve the theoretically predicted improvements in specific impulse. Two types of engines are under investigation.

The first is the low pressure rocket



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with the "conventional" Eject-A-Jet solid fuel motor. With a very low chamber pressure in the neighborhood of 0.2 psi and the 3,500-psi maximum temperatures of the heat exchanger matrix, a large percentage of the propellant will be desiccated when it leaves the engine with little or no water vapor remaining in the nozzle. The mass of the exhaust would be lowered and the specific impulse increased by as much as 40%. The curves on p. 129 are theoretical estimates of the performance of this type rocket.

Space Use

The low chamber pressure gives this rocket a small thrust capacity and a thrust-to-weight ratio of less than one, confining its use to space. Two possible advantages other than the improved specific impulse are an uncooled nozzle and no requirement for a propellant pump and gas turbine to drive it. Low pressure on the propellant tank would increase pump life, and radiation cooling of the nozzle might be adequate.

From a standpoint of possible gain in specific impulse, the nothermal nozzle is much more attractive than the low pressure rocket. The principal point is to show that the walls of a heated nozzle would add a large amount of energy to a supersonic flow of desiccated propellant gas. Heating a gas under these conditions is the exact reverse of the nose cone cooling problem during high velocity reentry into the atmosphere.

Theoretically, it appears that heat transfer from a wall to a gas will be more effective if the gas is partly desiccated. The heat transfer is proportional to the difference between wall temperature and the temperature the gas reaches simply by passing through the boundary layer and being brought to rest at the wall surface. The latter is lowered as the absolute wet temperature is a non-desiccating gas, this temperature is high and not too different from the gas stagnation temperature.

The heat transfer in this case would be low.

If a desiccating propellant is considered, the degree of desiccation increases as the relatively "cold" propellant moves toward the heated walls and its velocity drops. The absolute wet temperature of this propellant is well below that of the non-desiccating type because the "energy sink" of desiccation reduces the stagnation temperature.

Therefore, the heat transfer to a desiccating gas is high when compared with the non-desiccating case. One of the big questions surrounding the practical use of this mechanism is the diffusion rate of the "cold" gas through

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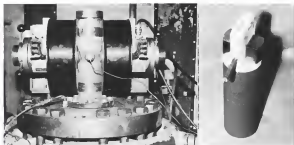


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General Electric IAN Generator Has Space Application

General Electric has successfully obtained electrical power from an ionized gas flow with a new device called a magnetohydrodynamic generator. Absence of moving parts makes a neat possibility for an auxiliary power source for space vehicles. Prototype IAN generator, shown at left, is built to top of General Electric's large air jet, the source of the ionized gas is rocket exhaust or other high temperature gas—less 3,000°—also would suffice. Vertical steel cylinder in the center, flanked by the two poles of an electromagnet (black, retinal), contains the heart of the unit—a welded quartz generator with a narrow channel located on top of a hollow graphite cylinder. The graphite cylinder (above right), directs the hot ionized gas into the quartz channel and out the top of the cylinder. Attached to opposite narrow ends of the quartz channel and penetrating through the steel casing are two graphite electrodes. Flash against the broad ends of the quartz channel are the pole pieces that carry the magnetic field in the slots of the quartz channel. In operation, the hot ionized gas flows up between the poles of the electromagnet, striking the magnetic lines of force and creating a voltage.

the boundary layer. If it turns out that this rate is much lower than predicted, very long needles would be needed to add a useful amount of energy to the exhaust.

The weight of these needles could perturbate their use.

Potential Speed

It is believed by those studying the problem that energy addition in a series of reasonable lengths will allow exhaust. Much research approaching five.

The curve on p. 128 shows that the acceleration might allow the specific impulse to be improved by a factor of three if propellant with high gamma such as highly dissociated hydrogen were used.

Schubert's, the appearance of a rocket motor with an isothermal nozzle is shown on p. 125 (bottom). The thrust-to-weight ratio of such an engine would be less than unity because of its large size and low chamber pressure. It would be useful only in space.

New experimental program at Princeton now being planned is designed to prove or disprove these predictions. Methods or means will be used to determine the exact effectiveness of supersonic heat transfer to dissociating gases.

Soviets Say Moon's Far Side Shows Continental Structure

Washington—Far side of the moon has a predominantly continental structure with lower "seas," Russia and now then the near side, according to Soviet scientists who have studied photographs of the moon's far side taken by Kosmos lunar probe (AV Oct. 12, p. 28, Nov. 2, p. 26).

This is "extremely important for answering the question of how the lunar relief was formed" and a contribution to the theory held by French astronomer that there should be a large sea in the center of the far side. Alexander Nikonov, head of a planetary study group at Leningrad's Pulkovo Observatory, told Tass news agency. Nikonov said the photographs are being studied to see whether craters produced by Williams of Britain are located as his hypothetical chart shows.

Further Studies

Further astronomical and geological studies will be made by rockets to help determine what large depressions or "seas" developed on the side but not the far side, Nikonov said. Soviet scientists believe this happened because

greater temperature fluctuations occurring on the near side during lunar eclipses "caused a more extensive cracking of the lunar crust on this side." Another factor influencing formation of the relief of the moon's reverse side is that it is not shielded by the earth from the asteroids that strike it in greater quantities than the visible lunar disk.

Finally, influenced by the earth's gravitational pull, the tidal waves on the lunar crust and core should be stronger on the northward side of the moon.

Farer Features

Lunar geologist Vladimir Yermakov of the Kharkov Observatory was quoted by Tass as saying that the far side has lower features than the 500 or so that appear on the near side.

Yermakov said the photos of the far side lack the white craters that are clearly noticeable on photos taken of the earthward side of full moon. Although the nature of the craters has not been finally established, many years of work at the observatory headed by Nikolai Bershteyn "permit us to make the belief

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- Threshold Resolution: 0.0001 G
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- Natural Frequency: 16 to 100 cps
- Cross-Axis Sensitivity: 0.005 G per G maximum
- Shock to 40 G
- Vibration: 10 G to 2000 cps
- Size: 1 1/2" diameter, 3 1/2" long
- Weight: 1.3 lbs maximum



TYPE LA-700
shows actual size

- Full Scale Range: ± 1 to ± 20 G
- Full Scale Output: 10 Vdc
- Threshold Resolution: 0.0001 G
- Damping Ratio: 0.6 to 0.9 typical
- Natural Frequency: 5 to 20 cps
- Cross-Axis Sensitivity: 0.005 G per G maximum
- Shock to 100 G
- Vibration: 12 G to 2000 cps
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Honeywell

 Military Products Group

at those on trajectories of some white space filling in the narrow and deep tail finures." This said,

"Detailed analysis of the laser photos I acquire more than a month, according to Alexander Nevskiy, head of the Soviet Academy of Sciences. He said the penetration of outer space has to be 'such during days and nights' the laser probe 'will not stop'.

Possible because of the sun's influence on the trajectory, the photographic shot's exposure is increasing, having reached 300,000 sec from earth on Oct. 6, the Russians said. Consequently, the altitude of the probe is decreasing, the probe should pass to the south of the moon on its next close approach, it did on the photographic run, the probe's life would be greatly increased, he said.

James Report

Possibly through a translation error, an report here indicated that the first of several Soviet lunar probes might be carried on a rocket. That report, unrelated from Pravda, did not agree with a Tass report of the same day.

"The overall volume of scientific information transmitted along the radio contact channel, including shots of the signs of the moon, greatly surpassed volume of photographic information which was transmitted from the first several Soviet lunar rockets," Pravda report said. "The first rocket and almost the next planning, but not include the word 'astronomic'."

Signals carrying the photo images were recorded on earth by four different units, according to Pravda. It said the recording was done "by special devices in a photographic film, on tape recording a high degree of stability tape speed, on long-persistent cathode ray tubes, and on space recording devices using electrochemical paper."

Convair Establishes Space Research Unit

St. Louis, Tenn.—An applied research unit which will concentrate totally at the environments and conditions surrounding space vehicles has been formally created at Convair's St. Louis Division. Such knowledge is essential to the design of vehicles of the type Convair anticipates for the future, according to physicist Dr. E. Louis Scott, who is in charge of the new section.

Initially the section, a part of the technical engineering department, will concentrate on such subjects as the nature of the outer atmosphere, physics of high-energy particles and astronomical forces.

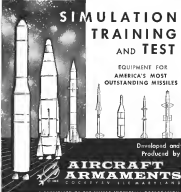


Lewis Research Center Space Ship Concept

Lewis Research Center concept of a hypothetical two-stage chemical rocket space vehicle would carry eight men on a round trip between earth and Mars satellite orbits. Upper structure at right is detachable living quarters, men also carries the chemical rocket vehicle to a safe landing on Mars. "Spill day" fuel is designed for operations in gravity-free area, not to land on Mars, according to National Aeronautics and Space Administration.

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ship of \$2,433,693 or \$8.47 a share on sales of \$95,157,661. This compared with earnings of \$3,012,371 or \$1.22 a share on sales of \$106,003,509 last year. This represented an increase in profit margin from 1.8% last year to 2.4% this year. Backlog on Sept. 30 was \$633 million compared with \$472 million on that date last year.

New Offerings

Hedemores, Inc., Livingston, N. J., principal business the manufacture and sale of ball valves used in the marine and marine industries. Offering is 105,000 shares of common stock for public sale; 50,000 shares to be sold by the company; and 25,000, representing outstanding stock, in the present offering. Proceeds will be used to working capital, to purchase additional machinery and to purchase additional machinery and equipment.

Transwest Gas Transmission Co., Houston, Tex., owner of a half interest in Grand Central Rocket Co., Redwood, Calif. Offering is 300,000 shares of convertible convertible secured preferred stock (\$300 par) for public sale. Proceeds will be applied against outstanding short-term notes issued under the company's revolving credit agreement, proceeds from which were used in the expansion of company properties. The current expansion program will require expenditures of \$64 million.

Dyn-Therm Chemical Corp., Cedar City, Calif., principal business the manufacture and sale of flame-retarding and heat-resistant coatings, including a non-toxic coating for military and industrial use. Offering is 200,000 shares of capital stock for public sale at \$5 per share. Proceeds will be used to pay a part of the purchase price of the stock of Dyn-Kon Corp., a subsidiary, to pay a \$60,000 bank loan; the balance for working capital.

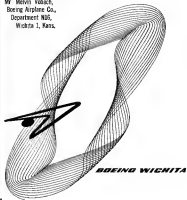
Consolidated Diesel Electric Corp., Stamford, Conn., engaged in the design and production of specialized lines of equipment for the support and servicing of missiles and satellites and commercial aircraft. Offering is \$1,000,000 of 6% convertible debentures due 1977, for public sale at 100% of principal amount. Proceeds will be used to discharge "Senior indebtedness" of subsidiaries, to replenish working capital, to finance increasing commercial business of the parent and subsidiaries, and other corporate purposes. The company has arranged to procure a long-term loan, conditional upon sale of the debentures, the proceeds to be used in large part to refund most of the out-

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for holders of advanced degrees now exist in Boeing Wichita's tremendously expanded language research and development program for **PHYSICISTS** or **ELECTRICAL RESEARCH ENGINEERS** to conduct acoustics and noise control research supporting advanced designs; to analyze survival properties of advanced vehicles in present and future environments, and evaluate the potential of vehicle defense proposals...

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Jack Lacey, Chief of Operations,
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“The people I want have a minimum of two years’ (and up to twenty years’) experience in such areas as precision gyro magnetism, gyro magnetism, digital data handling, electronic packaging, advanced instrumentation, or magnetic component design.

“If you are such a person, I’d like to hear from you. Just drop a line to my technical director, Mr. Bruce D. Wood, including pertinent information on your background, interests, and accomplishments. He’ll arrange a meeting—to answer your questions—on during your plans and the possibility of a career with Honeywell.”

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standing obligations incurred to finance the acquisition of the business were collected by the Harwood Valve Corp. subsidiary.

Gulton Industries, Inc., Metuchen, N. J., will offer 600,000 shares of common stock, the proceeds to be used for general purposes including retirement of \$300,000 of bank loans incurred to carry inventories and a \$300,000 program to build and equip a new plant for the company's battery division. The company develops and manufactures electronic, electro-mechanical, and electro-mechanical components and machinery for military and commercial use.

Mergers And Acquisitions

Del Mar Engineering Laboratories of Los Angeles has acquired Electronics Co., Santa Monica, Calif., a wholly-owned subsidiary which will provide Del Mar with a separate facility and organization for missile subsystem development. No management changes are anticipated. The subsidiary will serve as a military sales company engaged in research and development. Electronics has been manufacturing components for missile guidance applications, and producing Kinescan motion picture control equipment.

Consolidated Electronics Corp. and Bell & Howell Co. boards approved merger terms calling for distribution of three Bell & Howell shares for each four new Bell and for Consolidated shareholders to receive one share of the Bell & Howell common for one of Consolidated following the move. Consolidated makes search and missile test equipment, electronic instrumentation, magnetic tape for data processing and vacuum systems and controls.

Stearns Chemical Co. is proposing a merger with Victor Chemical Works on the basis of exchanging one share of Stearns common for one share of Victor, exclusive of Victor shares already owned by Stearns, and one share of Victor preferred for a newly authorized share of Stearns 3 1/2% cumulative preferred.

Telecomping Corp., Los Angeles, acquired the Merwin Division Corp., a wholly-owned subsidiary of the Carrier Corp., for a purchase price in excess of \$2 million. The sale by Carrier shifts its interests for greater concentration in other areas, especially in its conditioning business. Merwin supplies structural subcomponents for the Boeing KC-119 and 317, wing tanks for the Lockheed F-104 and for various missiles including the Atlas and the Bomarc.

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Financial Briefs

General Process Equipment Corp. reports sales this year to exceed \$200 million for the first time. Nine-month sales totaled \$136,430,302 compared with \$122,777,431 for the same period last year and earnings increased sharply from \$915,612 to 1 cent a share last year to \$594,525 or \$1.38 a share. Backlog as of Sept. 18 was \$202 and, looking, compared with \$149 million Dec. 31, 1958.

International Aviation Underwriters, Inc., San Francisco, is a new aviation insurance pool, reportedly the first in the U.S. to have headquarters on the West Coast. Included in the pool are the Pacific Insurance Co., the Shipowners Insurance Co., the American Fire and Casualty Co., the St. Louis Fire and Marine Insurance Co., the Transit Casualty Co., the Equity General Insurance Co., the New Zealand Insurance Co. and the Standard Insurance Co. C. Anthony Winter is president.

Westinghouse Electric Corp. directors recommended a two-for-one stock split for shareholder approval. Reporting strong increases in defense orders, the company said sales for nine months were \$1,498 million compared with

\$1,394 million last year and net income was \$16,225,000 or \$3.17 a share, a 14.7% increase over the same period last year.

Radcliff, Inc., Melbourne, Fla., reported sales and earnings increased for its fiscal year ended Aug. 28. The comparable figures: sales this year \$84,865,734, last year \$81,079,684; earnings, \$588,991 or 66 cents a share this year, \$488,735 or 53 cents a share last year.

Loal Electronics Corp. reported first half sales of \$6,532,661, double the \$3,250,880 for the same period last year, and earnings of \$249,468, compared with \$12,040 a year ago.

Ryan Aeronautical Co. declared a regular quarterly dividend of 5 cents per share on common capital stock payable Dec. 4 to stockholders of record Nov. 13. Stockholders also approved increase in authorized common stock available for issuance from two to five million shares with a stock option plan for selected employees. Optional plan would be limited to 100,000 shares.

Rohr-Ross, Ltd. earnings are not coming up to expectations this year. Backlog is coming down and profit margins are getting narrower, the company says. In the last six months of

this year, total sales, at \$123.2 million, were \$2.8 million less than in the corresponding period of 1958. Backlog now stands at \$194 million, \$22.4 million less than in early 1959.

Perkin-Elmer Corp. reported sales increased 16% to \$17,514,079 for its fiscal year ended July 31. Earnings were \$906,776 or 83 cents a share after a stock split is 20% increase over last year's \$751,153 or 72 cents a share.

Spigler Corp. reported 1959 sales of \$77,074,442 and earnings of \$2,203,522 or \$3.36 a share for its 1959 fiscal year. Last year sales were \$72,955,449, and earnings were \$1,215,930 or 80 cents a share.

Thibault Chemical Corp. reported nine months sales of \$127,841,796 compared with \$144,607,976 for the same period last year. Earnings rose 134% to \$4,060,355 or 92 cents a share.

Garrett Corp. reported first quarter sales of \$10,027,782 and earnings of \$1,444,750 or \$1.45 a share. This compares with sales of \$77,698,430 and earnings of \$453,786 or 44 cents a share for the same period last year, marked by unusually heavy expense for projects.

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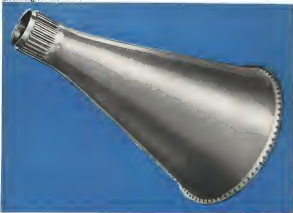
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WHO'S WHERE

(Continued from page 23)

Changes

John B. Norton, production engineering manager, Whittaker Controls Division, Telecommunications Corp., Los Angeles, Calif.

Robert E. Miller, manager, Advanced Development Staff, Helicopters, Inc., Falls Church, Va. Also: Dr. Charles E. Rupp, appointed to advisory on the staff.

National Engineering Science Co., Pasadena, Calif., has announced the following appointments to NESCO's senior technical staff: Dr. Robert Soderberg, Dr. George N. Tyson, Jr., and Dr. Robert Landman.

Nathan P. F. (aka) members, Lewis Department, Cincinnati, N. Y., Norton Division of United Aircraft Corp.

Bertine Klein, chief of structure, Seltzer Aircraft Co., San Diego, Calif.

John R. Jones, manager marketing operations, Erol McCulloch, Inc., San Carlos, Calif.

A. J. Quaderbach, assistant to the director of flight and testing, Douglas Aircraft Company, Inc., Santa Monica, Calif. R. W. Goodhart succeeds Mr. Quaderbach as testing division representative in the AFD weapons system office at Douglas El Segundo Division. Mr. Goodhart continues to test engine systems in the AFD weapons system office.

Sam E. Aronson, program director electronic products, General Instruments Division of General Dynamics Corp., San Diego, Calif. Also: Edward D. Byrd, senior manager, General Instruments.

General Electric Co., Flight Population Division, Greenville, S.C., has announced the following managerial changes: W. L. Harrow, manager product support, Production Engine Department, replacing N. F. Fuchsman, who is now manager of the engineering group, Jet Engine Department. Also: J. D. Wetzel, acting manager marketing, Production Engine Department.

Robert M. Gilis, manager of engineering, East Coast plant of Fairchild Controls Corp., Components Division, Hickory, N. C., a subsidiary of Fairchild Aircraft and Instrument Corp.

James D. Riddick, director of military operations, Remington Rand Union Division of Remington Rand Corp., with kind courtesy in Washington, D. C.

Lockheed Martin and Space Division, Sunnyvale, Calif., has announced the appointment of the following personnel: expert to the division's Satellite System Organization: Dr. Robert L. Murrain, Dr. John M. Coyne, Douglas F. Martin, Jr. and Dr. Rupp.

William E. Howell, assistant manager, Chemical Population Division, Hercules Powder Co.'s Explosives Department, W. R. Reynolds, Inc.

Richard W. Lenz, director of public relations, United Research Corp., Menlo Park, Calif., a subsidiary of United Aircraft Corp.

J. Lane West, associate laboratory director, Avionics Equipment Laboratory, ITT Laboratories Division of International Telephone and Telegraph Corp., Nutley, N. J.

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A. L. Feldman

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gaps warning light did not function properly after disengagement of the autopilot. The push trim potentiometer did not accelerate after autopilot disengagement. The mechanical centering of this trim potentiometer is necessary for the autopilot upon its engagement to have available full authority at no-draw time.

The principal components of the autopilot were bench checked. These checks disclosed a second master with the following exceptions:

2 When testing the autopilot computer it was found that the distance of delay K14 was erratic. Two of the contacts within this relay were the autopilot discharge warning light circuit. Definite correction of this was disclosed a considerable misalignment of an internal contact, suggestive of the type of damage which might be expected if the relay had been dropped. The distance from contact to center of the contact protrusion being below standard. In all other respects the relay appeared to be normal. Testing of the vertical gyro transmitter disclosed that the rate switch was inoperative.

3 The vertical gyro transmitter is an electrically driven gyro that provides the vertical reference for the automatic pilot. Incorporated in the assembly is a three-of-two control consisting of a hermetically sealed rate gyro and switch. At power-on, once the switch turns off the vertical gyro excitation source, thereby generating motion of the vertical gyro in a dynamic vertical swing time. Examination revealed that the rate gyro motor windings were open. A crack was the noted in the glass disk pot taking. Subsequent to the examining group's attention, flaring engineering personnel observed that the rate switch would occasionally stick when closed manually.

4 As had been previously observed during the autopilot system checks, the push potentiometer failed to re-center when the autopilot was disengaged. The unit was opened and it was observed that travel of the actuating lever was excessive, causing a slight binding of the lever. Subsequent to the group's examination, this assembly was inspected by Edgeline Process Division personnel at their plant. They reported finding some of the internal wiring composed within the subcircuit in such a way as to cause it stick.

4 Continued test runs indicated that a five-degree pickup change of attitude at a step was required for disengagement at normal rate. The five-degree step change operation was observed. It was also observed that the alarm would occur automatically at 10 day range without the step change of pitch attitude normally required for re-align. The activity of this indicator was associated with the autopilot and Mach trim system was checked by making accurate re-align measurements of all controls. In addition, the wiring in the trim control circuit, which traces the output of the autopilot manual clearance circuit, was removed and gave a desired zero indication.

These checks disclosed no irregularities in the present crash testing. The Mach trim system on the Boeing T7 is designed to aid in providing long radial stability during manual flight at

high speeds. This is accomplished by adjusting the position of the variable limit control indicator to constrain the speeds downwards inactivity at speeds of Mach 0.94 or above. This modernization at high speeds, in which use of a variable indicator, is a light readiness pertinent to all high-speed weapons aircraft. Although the T-77 aircraft is designed to be controllable throughout the Mach 7 zone, without the operation of the system, it is, however, required by Civil Air Regulations. The Mach trim system was tested and found to be operating in a normal manner. The Mach trim switch is located on an part of the shroudless chaffer, the crew members indicated that they believed this was the correct location for the switch.

The Mach warning system serves to alert the crew of the approach of limiting speeds. This is done by means of a visual and audible alarm. The system indicated that the bell center lock was loose, thereby producing a buzzing sound rather than the clear warning sound intended.

FLIGHT RECORDER

N 7129A was equipped with a Lockheed Aircraft Service Flight Recorder model C which continuously records and reproduces a cockpit's compass heading, magnetic altitude, vertical acceleration, and indicated air speed. The recorder in this aircraft is mounted on the left side of the vertical gyro excitation source, thereby generating motion of the vertical gyro in a dynamic vertical swing time. Examination revealed that the rate gyro motor windings were open. A crack was the noted in the glass disk pot taking. Subsequent to the examining group's attention, flaring engineering personnel observed that the rate switch would occasionally stick when closed manually.

5 The recorder is a device which continuously records and reproduces a cockpit's compass heading, magnetic altitude, vertical acceleration, and indicated air speed. The recorder in this aircraft is mounted on the left side of the vertical gyro excitation source, thereby generating motion of the vertical gyro in a dynamic vertical swing time. Examination revealed that the rate gyro motor windings were open. A crack was the noted in the glass disk pot taking. Subsequent to the examining group's attention, flaring engineering personnel observed that the rate switch would occasionally stick when closed manually.

When the recorder on N 7129A was inspected after the crash, it was determined that the flight supply had been exhausted at the time of the accident. Records revealed that the recorder SN 2163, had been installed on N 7129A on July 1959, by a PAVFIA mechanic who had obtained the recorder from the PAVFIA stock room at Lifshitz. The unit had been used in the dashboards used in return from Lockheed Aircraft Service following a repair by that organization. The mechanic verified that the time and the recorder had been used, but would be correctly, against the length of the tape. Measurement of the tape after the accident disclosed that



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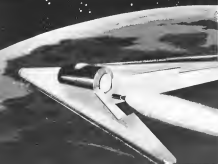
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instead of the usual 100 ft. length the tips were only 15 ft. long. Further investigation showed that 18 flight segments, covering 75.30 ft. were recorded on the tape from Jan. 21 until the tape was exhausted on a scheduled flight on Jan. 27, 1959. From this latter date new flights, covering 45.15 ft., were made during which subsequent small advances totaling .75 in occurred as a result of disposal of the existing tape using the full tape to the speed. The sixth flight was the one involved in the desert situation.

In an effort to derive as much information on the progress of the aircraft as might be feasible, the tape was returned to Lockheed Aircraft Service, Inc., at Ontario, Calif., where a detailed analysis of the contents of the record was made under the supervision of Lockheed Research personnel. Although the record was somewhat limited in the amount of information it gave of the tape, and although it was not short enough to permit the needed parameters relative to time, more valuable information was obtained by the examination. The strip, drawn from 15,000 ft. to 65,000 ft. in width and it was indicated that the exposed coating by the aircraft was representative of a Mach number of 2.05. The bearing trace was particularly difficult to read because of the poor record but it was indicated that the aircraft had made several turns in the desert, and that the aircraft was representing very high g forces not indicated, however, it is believed that these were too high and were probably influenced by the manner in which the record was made.

The flight recorder record was of particular interest in the desert investigation and it is noteworthy that owing to tape exhaustion a more reliable record was not obtained.

ANALYSIS

From all of the available evidence it appears that during the engine's absence from the cockpit the autopilot disengaged and the cockpit did not detect that the aircraft had entered a state condition of high speed. It is further evident that it entered this condition of speed without any abrupt movements. Also, since the engine's absence during the hours of darkness, the unaided divergent warning light is flashing and light should have been observed by the crew unless it either failed or was almost completely checked by the divergent cup. The latter appears probable as the tape was found in the ball end position at the top. The functional checks conducted on the autopilot system and its components did detect certain minor discrepancies. These could be attributed to what effect, if any, such discrepancies would have on the behavior of the aircraft under the conditions prevailing at the time of the incident.

According to crew testimony, the aircraft was cruising at an altitude of 15,000 ft. on March 1957, in straight and level flight; the autopilot was engaged and operating in the manual mode altitude hold was "on" and the autopilot was not in operation. On the three conditions the pitch rate pitch booster irregularly would remain inoperative and it would have no tendency to cause the aircraft to depart from the established climb condition.

The rate control of the vertical gyro trans-

mitter was inoperative. Specifically, the rate gyro sensor was found to have an open winding. This apparently was, directly, unable to respond to trans and would have prevented the system system to remain on at all times. Normally, the rate sensor in the autopilot system is designed to deactivate the control system during time to prevent motion of the vertical gyro in a high altitude vertical. However, during the flight and subsequent conditions of the single flight path, this malfunction would not have manifested itself.

Tests of the computer unit disclosed some abnormalities in the pitch rate condition. One involved abnormal disengagement in a 10-day manual attitude; however, this attitude is not pertinent to the level attitude of the computer in the aircraft. It was also slightly out of balance in response to a step change in pitch attitude; however, this also had made a low speed and low altitude. It is likely to engage the autopilot in response in a pitch up of the aircraft.

There was the only discrepancy involving components capable through malfunctioning of causing the autopilot to alter the established flight condition or cause into pilot disengagement. It was determined that the autopilot irregularities found, it is apparent that they were both minor in character and unable to have caused this disengagement. Although such minor discrepancies may occur in some circumstances, these may be expected of an autopilot of this type necessitating a computer attitude engaged to disengage the autopilot quickly should it sense any number of undesirable behavior or important in achieving the desired accuracy of the control system it is reasonable that any such discrepancies are corrected as the result of transient system signals. In this instance, the discrepancy also could have been the result of other autopilot up control in the cockpit of the behavior switch in the autopilot disengage (between both of which are on the control wheel) in its operating the autopilot engaged will be locked on the pedestal.

Functional tests performed on the Mach trim system disclosed that it was capable of normal operation. It must be considered that if a had occurred on the trim system, otherwise it would have provided enough static stability to stabilize the aircraft in Mach trim condition. The crew reported a change in attitude from a high altitude. This did not result from a malfunction of the Mach trim system but could have resulted from a violent pressure upon the electric stability bar which located on the control wheel. Although Capt. Peters testified that he is quite certain he did not touch the bar with it remote, after careful consideration, the only logical explanation for the trim system behavior is it was definitely locked in Mach trim condition and not back much to not function when he attempted to use it after returning to his seat. It may have been caused by which appears to be due to high aerodynamic loads. In any event, it functioned in a normal manner when tested later.

It is evident that PAAW was in its possession of the flight recorder and a walk allowed a shorter than normal time to be used. This case resulted in the



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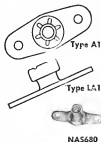


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